University of Alberta

A Legal Proposal for the Site-Specific Management of Scarce Ground Water Resources in Alberta

by

Ronald Timothy Hay ©

A thesis submitted to the Faculty of Graduate Studies and Research in partial fulfilment of the requirements for the degree of Master of Laws.

Faculty of Law

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Ronald Timothy Hay
#204 11503 100 Avenue
Edmonton, Alberta T5K 2K7

January 28, 1999

Because the existence, origin, movement and course of such [ground] waters, and the causes which govern and direct their movements, are so secret, occult and concealed . . . any attempt to administer any set of legal rules in respect of them would be involved in hopeless uncertainty, and would be, therefore, practically impossible.

Frazier v. *Brown*, 12 Ohio 294 at 311 (1861).

[J]ust as rules were hard to choose for groundwater law in the mid-nineteenth century, the legal choices remain just as hard to make for the late-twentieth century judicial decision makers. The reasons in the late-twentieth century relate to the nineteenth century's uncertainties of knowledge about groundwater, but, in addition, include uncertainties about economics, social values, and political decisions impacting on groundwater law. These factors are perhaps, even more occult and elusive than knowledge about the location and movement of water below ground.

E. F. Murphy, "The Recurring State Judicial Task of Choosing Rules for Groundwater Law: How Occult Still?" (1987), 66 Neb. L. Rev. 120 at 124.

University of Alberta

Faculty of Graduate Studies and Research

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled *A Legal Proposal for the Site-Specific Management of Scarce Ground Water Resources in Alberta* by Ronald Timothy Hay in partial fulfilment of the requirements for the degree of Master of Laws.

D. R. Percy

Professor David R. Percy, Q.C. (Thesis Supervisor, Faculty of Law)

Professor Elaine L. Hughes (Faculty of Law)

Ben Rostr

Professor Ben Rostron (Faculty of Science—Earth and Atmospheric Sciences)

Date: November 25, 1998

ABSTRACT

This thesis considers the legal means by which Alberta can achieve the maximum beneficial use of its ground water resources. It first describes the importance of ground water to Alberta. It also explains the historical evolution of Western ground water law. All doctrinal approaches to ground water management, including Alberta's system of "prior allocation," fail to allocate ground water efficiently. It is argued that doctrinal approaches fail because they do not adequately consider the value of ground water in varying social, economic, and hydrogeologic situations. Accordingly, this thesis suggests that a statutory framework—providing flexible, site-specific management criteria—is the best system for allocating ground water resources. Alberta's new *Water Act* arguably provides the framework for instituting effective site-specific ground water management initiatives as long as the discretionary powers under the Act are exercised for this purpose.

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AUTHOR'S NOTE

The author commenced this thesis during his period of residency in the Master of Laws Programme at the University of Alberta (from September 1995 to May 1996). After completing his course work requirements in May 1996, the author's employment with a natural resources company and the Court of Appeal of Alberta deferred the completion of this thesis until the spring of 1998. During this same time period the Alberta Legislature made several revisions to what was (as of February 23, 1998) the unproclaimed Alberta *Water Act*, S.A. 1996, c. W-3.5. On October 7, 1998, the *Water Act* was proclaimed in force by Order in Council 413/98. The *Water Act* comes into force on January 1, 1999. The author has tried to update his thesis and state the law as of February 23, 1998, when he finished his research and writing. Any errors or omissions are, of course, his own.

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CHAPTER ONE

Ground water is a vital resource: It is four hundred times more abundant than surface water and accounts for two-thirds of the world's fresh water.[1] In Canada, thirty percent of the population depends on ground water as its source of drinking water.[2] In Alberta, twenty-seven percent of the population receives all or part of its drinking water from ground water sources.[3] Despite the obvious importance of ground water to humans and the natural world, ground water remains an underregulated and mismanaged resource.[4] But unlike other environmental problems of the twentieth century, ground water management is not hamstrung by inadequate scientific knowledge. Hydrogeologists are able to explain a great deal about the quantity, quality, and movement of ground water with the aid of modern technology. The challenge facing ground water management is to determine how government, administrators and law-makers should allocate finite ground water resources amongst the population. In this regard, one could say that

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[1] W. O. Karvinen & M. L. McAllister, *Rising to the Surface: Emerging Groundwater Policy Trends in Canada*, (Kingston: Centre for Resource Studies, 1994) at 3 [hereinafter Karvinen & McAllister].

[2] P. Muldoon & M. Valiante, *Toxic Water Pollution in Canada: Regulatory Principles for Reduction and Elimination*, (Calgary: Canadian Institute of Resources Law, 1989) at 16.

[3] P. J. Hess, "Ground-Water Use in Canada, 1981", National Hydrology Research Institute Paper No. 28 (Ottawa: NHRI Inland Waters Directorate, 1986) at 15 [hereinafter Hess].

[4] As one author states:

> Canadians apparently place a high value on groundwater resources in some philosophical sense and, as a society, seem prepared to spend very large sums to clean up contaminated groundwater resources. At the same time, we treat groundwater as essentially a free good. . . . [A]s a result, withdrawals are poorly managed, little consideration is given to the possibility of contaminating groundwater when decisions are made about locating facilities or undertaking activities and little attention is given to ways of using groundwater more efficiently.

W. B. Trusty & Associates, Ltd., "The Social, Economic and Environmental Value of Groundwater in Canada", Unpublished report to the Inland Waters Directorate Environment Canada (Merrickville: March 1991) at iv.

Professors Freeze and Cherry— the authors of the leading text on ground water hydrogeology— were prophetic when they said in 1979:

> We perceive a trend in the study and practice of groundwater hydrogeology. We see a science that is emerging from its geological roots and its early hydraulic applications into a full-fledged environmental science. We see a science that is becoming more interdisciplinary in nature and of greater importance in the affairs of man.[5]

One hopes that this thesis follows the lead of Freeze & Cherry and certain natural resource lawyers by exploring the inter-disciplinary, legal and institutional aspects of the environmental science of ground water hydrogeology.

This thesis proposes that a flexible system of ground water management is best suited to Alberta's varied hydrogeology and diverse patterns of water use. Local management entities may be best able to manage relatively isolated ground water reservoirs that supply a small, cohesive community of users with ground water for domestic and agricultural use.[6] By comparison, large interconnected ground water systems (often located near large urban centres) may be best managed by a governmental or centrally administered body with input from local stakeholders.

This thesis uses five stages to develop its flexible ground water management proposal for Alberta. This first chapter describes ground water as a physical resource and its importance to Alberta. Chapter Two identifies how different jurisdictions, including Alberta, have used different legal doctrines to manage ground water. Chapter Three demonstrates that no one legal doctrine effectively allocates ground water during times of shortage. Rather, only site-specific management plans and remedial ground water programs provide effective hydrogeologic solutions to persistent ground water problems. Chapter Four explains how local, regional and centrally-administered management bodies have effectively controlled ground water problems in different hydrogeologic situations. Finally, Chapter Five proposes a multi-entity ground water management framework for Alberta, using local management bodies in areas of isolated and moderate ground water use, and centrally administered bodies in areas of interconnected and heavy ground water use.

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[5] R.A. Freeze & J.A. Cherry, *Groundwater* (Toronto: Prentice-Hall, 1979) at xv [hereinafter Freeze & Cherry].

[6] As will be described later in this thesis, no ground water reservoir is truly "isolated" from water in other phases of the hydrological cycle. Nevertheless, this thesis will show that smaller, more isolated ground water reservoirs are often better managed by local management entities.

The author of this thesis must acknowledge from the outset that he is not a hydrogeologist. This thesis does, however, set out certain hydrogeological principles which were drawn from general research and which appear from a nonspecialist viewpoint to be defensible from both hydrogeological and legal perspectives. Only laws based on hydrogeological fact have any hope of success, and lawyers, scientists and policy-makers must work together to implement such laws. The author intends for this thesis to contribute to the body of such interdisciplinary research.[7]

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[7] Note that the first lawyer to take an interest in ground water may have been Pierre Perrault, who held administrative and financial positions with the French government. His 1674 publication, *De l'Origine des Fontaines*, undertakes a scientific analysis of the resource and is dedicated to the Dutch mathematician and physicist, Christiaan Huygens. D. K. Todd, *Groundwater Hydrology*, 2d ed., (Toronto: John Wiley & Sons, 1980) at 5 [hereinafter Todd]. Incidentally, Perrault's more well known

A. Ground Water: Nature of the Resource

Ground water represents one phase of the hydrological cycle. That cycle describes the endless circulation of water between the oceans, atmosphere, and land.[8] As Freeze and Cherry describe:

> Inflow to the hydrologic system arrives as *precipitation*, in the form of rainfall or snowmelt. Outflow takes place as *streamflow* (or runoff) and as *evapotranspiration*, a combination of evaporation from open bodies of water, evaporation from soil surfaces, and transpiration from the soil by plants. Precipitation is delivered to streams both on the land surface, as *overland flow* to tributary channels; and by subsurface flow routes, as *interflow* and *baseflow* following *infiltration* into the soil.[9]

Ground water is part of the land-based component of the hydrological cycle. Individual "watersheds" form the land component of the hydrological cycle.[10] Watersheds are areas of land that receive precipitation, create surface flow, generate evapotranspiration back into the atmosphere, and replenish the unsaturated soil moisture zone and saturated ground water zones beneath the earth. Watersheds can thus be thought of as sub-systems in the hydrological cycle. A good deal of water stays within a watershed, moving between land, the atmosphere, and underground zones. Overuse of water in one watershed affects its residents directly, but only incrementally affects residents in neighbouring watersheds.

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brother, Charles, is best known for the fairy tale: *Mother Goose.*

[8] Freeze & Cherry, *supra* note 5 at 3.

[9] Freeze & Cherry, *supra* note 5 at 4.

[10] *Ibid.*

Watersheds and their associated underground ground water "basins"[11] form logical boundaries for water management because their problems and solutions almost always exist within that area.[12] Ground water generally resides within a watershed's underground basins for much longer periods of time than water in surface streams, rivers and lakes. On average, the entire volume of water in a river is replaced once every two weeks, whereas ground water turnover is much slower.[13] Ground water may reside within the geologic structures of a basin for thousands of years before a full water exchange takes place.[14]

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[11] See generally Todd, *supra* note 7 at 47.

[12] W. Goldfarb, "Watershed Management: Slogan or Solution?" (1994) 21 Boston Coll. J. of Env. Affairs 483 at 484-485.

[13] Freeze & Cherry, *supra* note 5 at 5.

[14] *Ibid*. Scientists have used carbon-dating techniques to discover that certain ground water supplies may be thousands of years old. Water samples taken from deep well in deserts of the United Arab Republic and Saudi Arabia indicate ages of 20,000 to 30,000 years. Todd, *supra* note 7 at 25. The slow turnover of groundwater within an underground flow system means that contaminants may stay in the same flow system for generations. Given this problem, and the fact that most of the world's fresh water is contained in underground reservoirs, ground water pollution prevention is a key component of any system of ground water law. Due to space limitations, this thesis only addresses the quantitative aspects of ground water management, leaving qualitative considerations for another day. One may argue though, that ground water pollution prevention is compatible with local and centrally administered management entities. National water standards and local land use regulations can be implemented by either provincial or local authorities. Writers are now recognizing that local land use planning, an activity entirely compatible with local ground water allocation, is an essential method of ground water quality protection. See D.R. Madelker, "Controlling Nonpoint Source Water Pollution: Can it be Done?" (1989) 65 Chicago-Kent L. Rev. 479. L.A. Malone, "The Necessary Interrelationship Between Land Use and Preservation of Groundwater Resources" (1990) 9 U.C.L.A. J. of Env. L. 1. P. Muldoon & M. Valiante, *Toxic Water Pollution in Canada: Regulatory Principles for Reduction and Elimination* (Calgary: Canadian Institute of Resources Law, 1989). D.A. Yanggen, "Zoning to Protect Groundwater Quality", in *Water Resources Law: Proceedings of the National Symposium on Water Resources Law* (American Society of Agricultural Engineers, 1986) at 104. D.A. Yanggen & L.L. Amrhein, "Groundwater Quality Regulation: Existing Governmental Authority and Recommended Roles" (1989) 14 Columbia J. of Env. L. 1. One author humourously conveys this idea by stating: "Putting a space station in orbit is a task that we can delegate to one agency; groundwater pollution control is not." E.T. Freyfogle, "Allocating the Groundwater Pollution Tasks: A Comment" (1989) 65 Chicago-Kent L. Rev. 429 at 433. Some municipalities in Canada have already undertaken local ground water pollution control initiatives compatible with the local form of management advocated

The term ground water "basin" is traditionally defined as a ground water system containing aquifers, aquitards, aquicludes[15] and other types of reservoirs.[16] Like watersheds, ground water basins form ideal management units because water consumption overlying these structures has a direct impact on the sustainability of the resource. Professor Todd explains the importance of the basin-management concept as follows:

> A *groundwater basin* may be defined as a hydrogeologic unit containing one large aquifer or several connected and interrelated aquifers. Such a basin may or may not coincide with physiographic unit. In a valley between mountain ranges the groundwater basin may occupy only the central portion of the stream drainage basin. In limestone and sandhill areas, drainage and groundwater basins may have entirely different configurations. The concept of groundwater basin becomes important because of the hydraulic continuity that exists for the contained groundwater resource. In order to ensure continued availability of subsurface water, basin-wide management of groundwater . . . becomes essential.[17]

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in parts of this thesis. See J.L. Sponagle, "From the Groundwater Up: The Management and Protection Strategy for the North Tyndal Groundwater Supply for the Town of Amherst, Cumberland County, Nova Scotia" in *Water and the Wilderness: Development, Stewardship, Management* (Ottawa: Canadian Water Resources Association, 1993).

[15] Freeze & Cherry, *supra* note 5 at 47 define aquifers, aquitards and aquicludes as follows:

> An *aquifer* is best defined as a saturated permeable geologic unit that can transmit significant quantities of water under ordinary hydraulic gradients. An *aquiclude* is defined as a saturated geologic unit that is incapable of transmitting significant quantities of water under ordinary hydraulic gradients.
>
> * * * *
>
> In recent years the term *aquitard* has been coined to describe the less-permeable beds in a stratigraphic sequence. These beds may be permeable enough to transmit water in quantities that are significant in the study of regional groundwater flow, but their permeability is not sufficient to allow the completion of production wells within them. Most geologic strata are classified as either aquifers or aquitards; very few formations fit the classical definition of an aquiclude. As a result, there is a trend toward the use of the first two of these terms at the expense of the third.

The word aquifer can be traced to its Latin origin. *Aqui-* is a combining form of the term *aqua* (or water) and *-fer* comes from *ferre*, meaning "to bear". Todd, *supra* note 7 at 26.

[16] See Todd, *supra* note 7 at 47. See also Freeze & Cherry, *supra* note 5 at 47.

[17] Todd, *supra* note 7 at 47.

Most ground water management plans use the basin-management concept. However, hydrogeologists have recently discovered that ground water storage and depletion does not always confine itself to a discrete ground water basin within a watershed. In light of this fact, a contemporary definition of a ground water basin should be used in ground water management efforts. For example, the University of Arizona's Water Resources Research Center now defines a ground water basin as: "A hydrologic unit of groundwater storage defined as an area more or less separate from neighbouring groundwater storage areas."[18] The Arizona definition recognizes the inter-connectedness of many ground water systems, while acknowledging that ground water often resides within traditionally conceived basin boundaries. So long as water managers recognize that ground water may be stored or depleted from areas outside the traditional definition of a ground water basin, the basin-management concept remains a valid tool for ground water management planning.

With regard to the properties of ground water within a basin, one must first know that "ground water" is not all water located beneath the surface of the earth. Ground water, properly defined, is subsurface water that occurs below the water table in saturated soil.[19] Water in the soil above the zone of saturation—like the water a few feet beneath the grass in your back yard—is actually surface water. Only water that fills all the interstices in consolidating material below the water table is ground water. Only ground water—or water in the "saturated zone"—is ordinarily capable of being recovered or pumped to the surface.

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[18] See the glossary appended to the "Water Center Home Page" of the College of Agriculture, University of Arizona, available at: http://ag.arizona.edu/AZWATER/glossary/grndwatr.html.

[19] M. P. Anderson, "Hydrogeologic Framework for Groundwater Protection", in G. W. Page, ed, *Planning for Groundwater Protection*, (Toronto: Academic Press, 1987) at 3 [hereinafter Page]. See also Freeze & Cherry, *supra* note 5 at 2.

For the purposes of this thesis, it is impractical to refer to the multitude of ground water structures with technical precision. Rather, this thesis will adopt certain functional definitions. Those ground water reservoirs that yield sufficient supplies of ground water to make them susceptible to over-consumption and mismanagement will be called "aquifers".[20] A variety of aquifers contain ground water, some of which "recharge" with

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[20] Ground water scientists generally distinguish between two types of aquifers based on their physical attributes:

> *Porous media* are those aquifers consisting of aggregates of individual particles such as sand or gravel. The groundwater occurs in and moves through the openings between the individual grains. Porous media where the grains are not connected to each other are considered *unconsolidated*. If the grains are cemented together, such aquifers are called *consolidated*. Sandstones are examples of consolidated porous media.
>
> *Fractured aquifers* are rocks in which groundwater moves through cracks, joints or fractures in otherwise solid rock. Examples of fractured aquifers include granite and basalt. Limestones are often fractured aquifers, but here the cracks and fractures may be enlarged by solution, forming large channels or even caverns. Limestone terrain where solution has been very active is termed *karst*. Porous media such as sandstone may become so highly cemented or recrystallized that all of the original space is filled. In this case, the rock is no longer a porous medium. However, if it contains cracks it can still act as a fractured aquifer.

See Environment Canada, "Groundwater - Nature's Hidden Treasure" available at: http://www.ec.gc.ca/water/en/info/pubs/FS/e_FSA5.htm. Within the above two general types of aquifers there also exist "confined" and "unconfined" aquifers.

> Unconfined aquifers are those that are bounded by the water table. Some aquifers, however, lie beneath layers of impermeable materials. These are called confined aquifers, or sometimes artesian aquifers. A well in such an aquifer is called an artesian well. The water in these wells rises higher than the top of the aquifer because of confining pressure. If the water level rises above the ground surface a flowing artesian

water from the hydrological cycle. Aquifers will thus be referred throughout this thesis as "recharging" or "nonrecharging" aquifers. The rate at which an aquifer recharges is critical to the management of the resource. Recharging aquifers are often optimally managed at consumption levels that do not exceed their recharge rates. When consumption is equal to or less than an aquifer's recharge rate the sustainability of the resource is maintained.[21] When consumption exceeds available recharge an aquifer goes into "overdraft".[22] Overdraft is a critical problem for ground water managers because overdraft threatens the sustainability of the aquifer and affects the people and ecosystems that depend on this resource. Overdraft not only reduces the quantity of water in an aquifer, but it also makes an aquifer more sensitive to pollution.[23] Although overdraft is not a critical problem in Alberta, overdraft conditions may develop in the future unless effective ground water management is undertaken.

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well occurs. The piezometric surface is the level to which the water in an artesian aquifer will rise.

Ibid. See also Institute of Agriculture and Natural Resources, University of Nebraska-Lincoln, "Understanding Groundwater" available at: http://www.ianr.unl.edu/pubs/Water/g1128.htm.

[21] See F. J. Trelease, "Legal Solutions to Groundwater Problems—A General Overview" (1980) 11 Pacific L.J. 863 at 864 [hereinafter Trelease, "Overview"].

[22] See C.E. Corker, *Groundwater Law, Management and Administration*, (Arlington: National Water Commission, 1971) at 75-76 [hereinafter Corker].

[23] Higher concentrations of pollutants tend to accumulate in aquifers containing smaller volumes of water. See S. B. Peterson, Note, "Designation and Protection of Critical Groundwater Areas" (1991) B.Y.U. L. Rev. 1393 at 1397 [hereinafter Peterson]. Peterson also explains that when fresh water is withdrawn at a rate greater than an aquifer's recharge rate, "the resulting decline in pressure can allow saltwater to intrude into the aquifer." *Ibid.* Saltwater intrusion is a problem in coastal areas as well as areas like southern Alberta, where saline aquifers may be located close to freshwater supplies.

B. The Importance of Ground Water to Alberta

Although ground water quality and quantity is highly variable throughout Alberta,[24] ground water remains essential to the economic and social well-being of the Province.[25] One study reports that ground water represents only five percent of Alberta's total water allocation.[26] However, it is estimated that ninety percent of the rural population in the prairie region, including Alberta, relies on ground water as its primary source of water.[27] There is good reason to believe that ground water consumption also exceeds the amount cited in the statistics, for not all domestic wells are included in Alberta's ground water allocation figures and oil companies have, in recent years, used increasing amounts of ground water for oilfield injection purposes.[28] So even though ground water accounts for a relatively small percentage of the water used in Alberta, a significant number of Albertans rely on ground water to some extent.[29]

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[24] See generally M.E. Gordon, *A Survey of Concerns Regarding Groundwater Resources in Alberta*, (Edmonton: Environment Council of Alberta, 1981) at 8-12. Gordon summarizes that:

> Groundwater quality in the southern region tends to be marginal. The groundwater is usually potable, but is so high in iron, salts, and sulphate that it often requires treatment. Good aquifers are found sporadically. . . . Groundwater resources in central Alberta are generally plentiful and of reasonably good quality. . . . A large proportion of central Albertan communities depend on groundwater supplies. Exceptions include the largest communities such as Edmonton, Calgary, Red Deer, and Rocky Mountain House and communities located along the Battle, Red Deer and North Saskatchewan Rivers. . . . Groundwater is used extensively for municipal, domestic, industrial (especially oil and gas operations), and general agricultural purposes throughout [the northern region of the province]. This northern region is growing dramatically as a result of several large-scale petroleum developments. This has led to anticipation of a considerable increase in groundwater use. . . .Water quality problems primarily involve high mineral content (sulfates and iron). Treatment is frequently required.

Ibid.

[25] Prairie Provinces Water Board, *A Review of Groundwater Legislation in the Prairie Provinces*, Report No. 117 (Feb. 1991) at 1 [hereinafter PPWB].

[26] See D.R. Percy, *The Regulation of Ground Water in Alberta*, (Edmonton: Environmental Law Centre, 1987) at v [hereinafter Percy].

[27] See PPWB, supra note 25 at 1. In 1989, 70% of the ground water withdrawn in Alberta went to agricultural users; 15% to oilfield injection users; 14% to municipalities; and 1% to industrial users. D.R. Percy, *Natural Resources Seminar Materials* (Edmonton: University of Alberta, 1995) at 2.

Moreover, ground water will continue to become more important in Alberta as surface watercourses approach full allocation in the southern half of the province.[30] Ground water is the only alternative supply of water for new or existing water users in Southern Alberta. New development will increase the incidence of water shortages and contamination.[31] Statistics acquired from Alberta Environment indicate such a trend:[32] Ground water accounted for forty-seven percent of new water allocations in 1995.[33] This percentage, relative to surface water allocations, is an all-time-high for the Province of Alberta. Additionally, contamination remains a serious problem near many old landfills, septic tanks, butane storage facilities, fertilizer plants, oilsands plants, pulp mills, irrigation farms, and tertiary oil recovery operations.[34] Because of these new pressures and persistent problems, one must question whether Alberta's existing system of ground water law is capable of adequately protecting the resource. These pressures and problems are complicated by the fact that many of Southern Alberta's most sensitive aquifers are "alluvial aquifers" which are interconnected with surface watercourses, such as the Bow River and Highwood River. Such aquifers exchange water with these heavily used rivers and affect the diverse group of users in an area of high water demand and limited water supply—the Bow Corridor.[35]

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[28] Percy, *supra* note 6 at iv, v.

[29] See Hess, *supra* note 3 (stating that 27% of Albertans receive all or part of their water from ground water aquifers). For a comprehensive analysis of the hydrogeology of ground water in Alberta see C. Pupp, R. Stein & G. Grove, "Groundwater Quality in Alberta: Hydrogeology, Quality Concerns, Management" National Hydrology Research Institute, Contribution No. 89051 (August, 1989).

[30] Personal Communication from Nga de la Cruz, Branch Head, Ground Water Rights Branch, Alberta Environmental Protection, to the author (1 November 1995) (concerning emerging ground water problems in Alberta) [hereinafter de la Cruz].

[31] de la Cruz, *supra* note 30.

[32] See Personal Communication from Janet Yan, Information, Operations & Support Unit, Water Resources Administration Division, Alberta Environmental Protection, to the author (15 November 1995) [hereinafter Yan].

[33] Yan, *supra* note 32. Statistics reveal a staggering increase in ground water allocations relative to surface water allocations. Between 1980 and 1989, only 3.1% of new water allocations were for ground water. This figure increased to 10.87% for the period 1990 to 1994. In 1995, nearly half of the new water allocations were for ground water. Note, however, that the increasing allocation of ground water merely illustrates to trend towards intensified ground water use. Surface water allocations still account for roughly 95% of the province's total water allocations. *Ibid.*

Alberta also has certain local ground water problems which generally affect smaller rural centres that depend on ground water for drinking water.[36] For example, during the 1980s a dispute arose between oil companies and domestic ground water users in Northern Alberta.[37] The oil companies wanted to use increased quantities of potable ground water for oilfield injection purposes. Domestic users relied on the same ground water supply for household purposes. In the end, domestic users succeeded in forcing the Department of Environmental Protection to announce a "Ground Water Allocation Policy for Oilfield Injection Purposes".[38] This policy prohibits oil companies from using more than fifty percent of the sustainable annual yield of an aquifer.[39] This policy was not the result of any physical water shortage, but was an *ad hoc* compromise between vastly different philosophies.[40] Domestic users wanted to reserve sufficient potable ground water for existing and future domestic users. Oil companies wanted to use unallocated ground water to maximize oilfield revenue. The Department's policy strikes a balance between these two views and illustrates the need for *specific* ground water management solutions.[41]

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[34] See *Environment Views*, Vol. 4, No. 2 at 21-24 (Edmonton: 1981).

[35] The Bow Corridor runs from Banff downstream to Medicine Hat. Along the way it passes through high-use water centres in Canmore, Calgary, and Brooks, Alberta. Intensive development of aquifers occurs near the Bow Corridor and the southern border of Alberta and Saskatchewan. PPWB, *supra* note 25 at 12-13.

[36] Recall that ninety percent of the rural population in Alberta rely on local ground water supplies derived from relatively small, isolated aquifers.

[37] See Alberta Water Management Review Committee, *Report of the Water Management Review Committee* (Edmonton, July 1995) at 44 [hereinafter WMRC Report].

Localized conflicts also occur between neighbouring ground water users who interfere with each others' ground water supply.[42] Water administrators have dealt with this problem by asking ground water users to make voluntary, pro rata reductions in ground water use.[43] This solution has no basis in law because Alberta uses a system of "prior allocation" to resolve water conflicts.[44] Prior allocation protects the rights of senior licensees to use their *full* allocation of water without interference from junior licensees.[45] Other jurisdictions, however, use site-specific ground water management plans to resolve these kinds of conflicts.[46] As this thesis will show, site-specific plans avoid several of the problems associated with the Alberta system, and with four separate doctrines of ground water law that have been used in various jurisdictions in Western North America.[47]

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[38] See "Ground Water Allocation Policy for Oilfield Injection Purposes" (Edmonton: Alberta Environmental Protection, March 1990) at 1 [hereinafter Oilfield Policy].

[39] See Oilfield Policy, *supra* note 38 at 1.

[40] See de la Cruz, *supra* note 30.

[41] An interesting question is whether the *ad hoc* Policy's 50/50 ratio is reflective of economic outputs in the area, or whether it also internalizes social and environmental values. Although the latter seems to be the case, this is impossible to know for sure because the Policy was a one-time administrative solution based on no statutorily enumerated criteria. In any event, the Policy could not be optimal at all times in all places.

[42] de la Cruz, *supra* note 30.

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[43] D. R. Percy, *The Framework of Water Rights Legislation in Canada* (Calgary: Canadian Institute of Resources Law, 1988) at 15 [hereinafter Percy, *Framework*].

[44] See *Water Resources Act*, R.S.A. 1980, c. W-5, as amended, s. 35(1) (priority of right to senior appropriators) [hereinafter cited as *Water Resources Act*].

[45] *Water Resources Act*, s. 35(1).

[46] See *e.g. Groundwater Management Act*, Ariz. Rev. Stat. Ann. ss. 45-401 to 45-636 (West 1994).

[47] The four doctrines of Western ground water law are: (1) rule of capture; (2) reasonable use; (3) correlative rights; and (4) prior appropriation. See J. L. Sax, R. H. Abrams & B. H. Thompson, *Legal Control of Water Resources*, 2d ed. (St. Paul, Minn.: West, 1991) at 378-392 [hereinafter Sax et. al]. The first doctrine or "rule of capture" is often described in the literature as the "English Rule of Absolute Ownership". *Ibid* at 378. There appears to be no consensus among commentators whether this rule is more properly termed a rule of capture or not. Even those who use the absolute ownership label often describe the doctrine in terms of "capture". *Ibid* ("the simple rule of capture that the absolute ownership doctrine offered had pro-developmental consequences . . .").

CHAPTER TWO

This chapter briefly describes the historical development of Western ground water law from the nineteenth century to the present. This account will also describe the development and current state of ground water law in Alberta. Subsequent chapters will then build on this historical information to identify: the doctrinal impediments to efficient ground water allocation (Chapter Three); a site-specific approach for managing scarce ground water resources (Chapter Four); and a legal framework for site-specific ground water management in Alberta (Chapter Five).

In setting out the basic doctrines of ground water law, this chapter will first identify how ground water rights developed in relation to riparian surface water rights. Second, this chapter will describe the English rule of capture in ground water. Third, this chapter will explain the American rule of reasonable use, the California doctrine of correlative rights, the doctrine of prior appropriation, and will describe how these three American doctrines developed to meet the inadequacies of the common law. Last, this chapter will describe ground water law in Alberta.

The origins of Western water law can be traced back to the common law of Nineteenth century England. By 1833 English courts had decided several cases involving conflicting surface water claims.[48] These cases, which involved disputes between upstream and downstream landowners, established the now famous doctrine of riparian rights.

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[48] P. Alston, *Legal, Institutional and Administrative Aspects of Groundwater Management in Australia* (LL.M. Thesis, University of Melbourne, 1976) [hereinafter Alston] at 15 (citing *Bealey* v. *Shaw* (1805),

At the time riparian theory was gaining momentum ground water claims were still being litigated using traditional theories of property and tort.[49] Courts did not directly consider whether an independent cause of action existed for interference with ground water supplies until a decade later in 1843.[50] This relative inattention to ground water made historical sense because of the scientific uncertainty about the nature and movement of ground water. So before English courts could consider policies important to ground water law, the law of surface water was already well established in the form of the doctrine of riparian rights.[51] A short description of the doctrine of riparian rights is thus a natural starting point for discussing ground water law.

A. Doctrine of Riparian Rights

The cornerstone of the doctrine of riparian rights is the idea that no one can obtain

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6 East 208, 102 E.R. 1266 (K.B.); *Williams* v. *Morland* (1824), 2 B. & C. 910, 107 E.R. 620 (K.B.); *Wright* v. *Howard* (1823), 1 Sim. & St. 190, 57 E.R. 76 (Ch.)).

[49] Alston, *supra* note 48 at 14. Early ground water cases involved consideration of one's rights in the resource after it was appropriated. For example, one court held that it was a tort for one landowner to divert ground water that was already at a neighboring landowner's well. See *Prickman* v. *Tripp* (1694), Skin. 389, 90 E.R. 173 (K.B.). However, such cases did not consider the right to unappropriated ground water flowing under one's land.

[50] *Acton* v. *Blundell* (1843), 12 M & W 324, 152 E.R. 1223 (Ex.) [hereinafter *Acton* cited to E.R.].

[51] See *Mason* v. *Hill* (1833), 5 B. & Ad. 1, 110 E.R. 692 (K.B.) [hereinafter *Mason* cited to E.R.].

ownership of surface water because it is *publici juris*[52]—a resource owned by the state in trust for its citizens.[53] Of that citizenry, only riparians—individuals owning land adjacent to watercourses—are vested with the incorporeal right to use surface water undiminished in quality and quantity.[54] Riparianism prevents upstream landowners from diverting quantities of water that interfere with the ability of downstream landowners to use the natural flow of the river.[55] Lord Denman formally announced the doctrine of riparian rights in the 1833 case of *Mason* v. *Hill*,[56] but perhaps the best summary of the doctrine was provided by Lord Parke in the 1851 case of *Embrey* v. *Owen*:[57]

> The right to have a stream flow in its natural state, without diminution or alteration, is an incident of property in the land through which it passes; but flowing water is *publici juris*, not in the sense that it is *bonum vacans*, to which the first occupant may acquire an exclusive right, but that it is public and common in this sense only that all may reasonably use it who have a right of access to it, and that none can have any property in the water itself, except in the particular portion which he may choose to abstract from the stream and take into his possession, and that during the time of his possession only. But each proprietor has the right to the usufruct of the stream which flows through his

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[52] *Ibid.* at 698. See also A.D. Tarlock, ed., *Law of Water Rights and Resources*, 7th release, (Deerfield: Clark, Boardman, Callaghan, 1995) c.3 at 5 [hereinafter Tarlock].

[53] See Tarlock *supra* note 52 at c.3 at 5. In researching the basis of English water law, Professor Weil showed that common law judges looked to the Institutes of Justinian in developing basic riparian theory. See S.C. Weil, "Running Water" (1909) 22 Harv. L. Rev. 190 at 191. Common law thus followed the Justinian principle that water was *res communes* or a thing owned in common "not susceptible of exclusive possession". *Ibid.*

[54] J.H. Bates, *Water and Drainage Law*, 10th release (London: Sweet & Maxwell, 1995) s.2.14 at 2005.

[55] G.V. La Forest, *Water Law in Canada: The Atlantic Provinces*, (Ottawa: Information Canada, 1973) at 206 [hereinafter La Forest].

[56] (1833), 110 E.R. 692 (K.B.).

[57] (1851), 6 L.R. Ex. 353, 155 E.R. 579 (Ex.) [hereinafter *Embrey* cited to E.R.].

land.[58]

Riparians are always allowed to use surface water for domestic activities such as cooking, cleaning, watering a household garden, and for domestic stock raising purposes.[59] Riparians may also engage in extraordinary nondomestic uses if these activities do not interfere with the quality and quantity of water flowing to downstream riparians.[60] Under this "natural flow" doctrine of riparian rights, any nondomestic use creating more than a *de minimis* interference with the natural flow of the water is actionable.[61] Plaintiffs can recover nominal, actual, or punitive damages for interference with riparian rights.[62] Courts can also issue injunctions against offending upstream uses.[63] Yet riparians must always allow others to use surface water for nonconsumptive purposes, such as navigation.[64]

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[58] *Ibid.* at 585-586.

[59] *A-G* v. *Great Eastern Ry.* (1870), 23 L.T. (N.S.) 344, Aff'd L.R. 6 Ch. 572 (Ch.).

[60] *Swindon Waterworks Co.* v. *Wiltshire & Buckinghamshire Canal Navigation Co.* (1875), L.R. 7 H.L. 697.

[61] *Wood* v. *Waud* (1849), 3 Ex. 748 (Ex.) at 780.

[62] See La Forest, *supra* note 55 at 211.

[63] *Harrop* v. *Hirst* (1868), L.R. 4 Ex. 43. See Bates, *supra* note 52 s.2.22 at 2008 ("plaintiff will be entitled to a declaration as to his rights and an injunction and/or damages."). Riparianism thus makes the distinction between domestic and nondomestic use very important in times of water shortage. For example, some riparians have creatively argued that large-scale ranching operations are "domestic" uses. This allows riparian ranchers who prevail on this argument to keep watering their livestock at times when riparian farmers might not be able to irrigate their crops. See *Miner* v. *Gilmore* (1859), 12 Moore, P.C. 131 at 156.

[64] *Marshall* v. *Ullswater Stream Navigation Co.* (1876), 1 App. Cas. 662 at 671.

Riparian theory was not universally well received in common-law countries. In the arid and semi-arid parts of Australia, the southwestern United States and western Canada, riparianism discouraged land development because it restricted the use of water to only those lands adjacent to watercourses.[65] The doctrine severely curtailed efforts to settle nonriparian dry lands where crops needed irrigation to survive.[66] Thus, the majority of western North America virtually abolished riparianism to promote agriculture and encourage settlement of dry lands.[67]

On the other hand, riparianism created an orderly system of water rights that worked well in water-rich areas like England, the eastern United States, and eastern Canada.[68]

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[65] See S.D. Clark and I.A. Renard, "The Riparian Doctrine and Australian Legislation" (1970) 7 Melb. U. L. Rev. 475 at 478.

[66] *Ibid.* at 479. Clark and Renard observe that the doctrine of riparian rights is "manifestly unsuited to an arid country where extensive irrigation well away from existing stream-beds would be necessary not only to ensure development but to sustain life." *Ibid.*

[67] Sax et al., *supra* note 47 at 10. Riparianism was originally adopted in all western states except for Utah and Wyoming. *Ibid.* at 37. The remaining dry inland states—Arizona, Colorado, Idaho, Montana, Nevada, and New Mexico—have since rejected riparian theory. *Ibid.* at 10. Today, California, Oregon, Washington, North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, and Texas follow mixed doctrines of riparianism and prior appropriation. *Ibid.*

In the Colonial era, all parts of Canada, except for Quebec, followed the doctrine of riparian rights. Percy, *Framework, supra* note 43 at 3. The four western provinces and the two northern territories in Canada—British Columbia, Alberta, Saskatchewan, Manitoba, the Northwest Territories, and the Yukon territory, respectively—are now governed by prior appropriation-type statutes. See *ibid.* at 30.

[68] See La Forest, *supra* note 55 at 175. Compare C.J. Meyers et al., eds., *Water Resource Management*, 3d ed. (Mineola, New York: Foundation Press, 1988) at 140-141 ("uncertainties occasioned by the flexibility of the riparian system have sparked the recent movement for new water-rights legislation in many eastern states, including provisions for the establishment of permit systems to provide a means of regulation, through administrative agencies, of existing and future water uses.") [hereinafter Meyers].

This success is reflected by the fact that most of these regions follow riparian theory today.[69] The doctrine's success in England might lead one to expect that the early common-law courts would also have imposed "riparian-like" restrictions on ground water withdrawals. However, the English courts did not apply similar restrictions to ground water, but instead allowed near absolute use and abuse of the resource.

B. Common Law Rule of Capture

The English rule of capture (also known as the rule of absolute ownership) was announced in the 1843 case of *Acton* v. *Blundell*.[70] The facts from the case are straightforward. The plaintiff claimed that the defendant's nearby coal pits reduced the amount of ground water flowing to the plaintiff's well.[71] The plaintiff argued that just as upstream riparians have to respect the reciprocal rights of downstream riparians, ground water users must respect the reciprocal rights of other water users.[72] Lord Tindal disagreed, for he believed that riparian rights were fundamentally different from ground water rights.[73] Riparian rights were open and notorious, whereas ground water rights were concealed by the movement of water "through the hidden veins of the earth."[74] This ancient distinction between surface water and ground water remains important today, not only because some jurisdictions still follow the rule of capture—allowing landowners to exploit all the ground water beneath their land—but because the entire framework of Western water law developed from the notion that ground water and surface water were *different* resources, requiring *different* methods of allocation.[75] The court was thus unwilling to limit one's right to a resource whose movement was unknown and unknowable.[76] Moreover, Lord Tindal commented that the absolute ownership rule was consistent with the common law, because the well established maxim *dominus soli est dominus ad coelum et usque ad inferos* gives landowners ownership in "all that lies beneath [the] surface" of their land.[77]

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[69] See Sax et al., *supra* note 47 at 10.

[70] 12 M & W 324, 152 E.R. 1223 (Ex.) [hereinafter *Acton* cited to E.R.].

[71] *Acton* (1843), 152 E.R. 1223 at 1223.

[72] *Ibid*. at 1226.

[73] *Ibid*. at 1233.

[74] *Ibid*.

Two subsequent English cases illustrate the harshness of the absolute ownership rule. First, the House of Lords held in *Chasemore* v. *Richards*[78] that a ground water user could deprive an ancient mill owner of the stream water necessary to run his mill.[79] The facts in this case illustrate the problem of conjunctive use: excessive withdrawals from one phase of the hydrological cycle (ground water) can adversely affect another phase of the cycle (surface water). Despite the interconnectedness of the water supplies and the mill owner's longstanding use, the court protected the well owner's ground water withdrawals under the rule of capture.[80] The court also attached no importance to the fact that the defendant was "exporting" the ground water to a nearby townsite, even though such an activity would be prohibited under riparian principles.[81] The "reasonableness" of the defendant's ground water use was thus not a proper legal consideration.[82]

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[75] See Corker, *supra* note 22 at v, 112. Corker's important work on ground water management identified the lingering, adverse effect of treating ground water and surface water as separate resources: "The law was in a period when the tide of classification ran strong. It classified doctrines and it classified types of water. . . . Unfortunately, classification often becomes a substitute for analysis. This seems to have been the fate of water law." *Ibid.*

[76] See *Acton* (1843), 152 E.R. 1223 at 1233.

[77] *Ibid.* at 1235.

[78] *Chasemore* v. *Richards* (1859), 7 H.L.C. 349, 11 E.R. 140 (H.L.) [hereinafter *Chasemore* cited to E.R.].

[79] *Chasemore* (1859), 11 E.R. 140 at 152.

The *Chasemore* opinion introduced another important proposition. Namely the distinction between "percolating ground water," which is subject to the rule of capture, and water flowing in "underground streams," which is controlled by the doctrine of riparian rights.[83] Although the distinction between types of ground water gave underground stream users the protection of riparian rights, it did little to curtail unreasonable ground water use. Unreasonable use continued because a person claiming riparian rights had the burden of proving that his or her water came from an underground stream.[84] Proof of this fact became near impossible as the court required "without opening the ground by excavation, or having recourse to abstruse speculations of scientific persons, men of ordinary power and attainments would know, or could with reasonable diligence ascertain that the stream when it emerges into light comes from and has flowed through a defined subterranean channel."[85]

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[80] *Ibid*. at 141, 152.

[81] *Ibid*. at 142. It will be recalled that riparians may only use water for domestic purposes on their own lands. If this same principle was extended to ground water users, ground water could not be transported off the overlying landowners lot. See *infra* note 100 and accompanying text. The disparate and unregulated treatment of ground water thus raises both quantity issues and allocation issues. Unlimited quantities of ground water can be abstracted under the rule of capture. And the rule of capture gives no consideration to the purposes for ground water abstraction and allocation.

[82] Alston, *supra* note 48 at 26. However, Lord Wensleydale dissented in *Chasemore* for the very reason that a landowner should have to use both ground water and surface water in a reasonable manner. See *Chasemore* (1859), 11 E.R. 140 at 155.

[83] *Ibid*. at 146-147.

Second, the rule of capture had its most questionable application in the 1895 House of Lord's case, *Mayor of Bradford* v. *Pickles*.[86] In *Pickles*, the defendant sank a mineshaft on his land to reduce the amount of ground water flowing to a well that supplied the residents of a nearby town.[87] The defendant had no intention of putting the captured ground water to any beneficial use and, instead, sank a spite well to force the town to buy his land.[88] Surprisingly, the House of Lords held that the defendant was within his rights to abstract water with the sole intention of keeping it from another! As per Lord Watson's reasoning: "No use of property which would be legal if due to a proper motive, can become illegal because it is prompted by a motive which is improper or even malicious."[89] A neighbour's only recourse in such situations was to deepen his or her existing well, or drill another well, to try and capture more ground water from the common source of supply.

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[84] Alston, *supra* note 48 at 20.

[85] *Black* v. *Ballymena Township Commissioners* (1886), 17 L.R. Ir. 459 at 474-475. The questionable distinction between types of ground water, like the distinction between surface water and ground water, remains law in many jurisdictions today. See Tarlock, *supra* note 52 c.4 at 7 (stating that Connecticut, Louisiana, Maine, Rhode Island, and Texas continue to follow the common law absolute ownership rule).

[86] [1895] A.C. 587 (H.L.) [hereinafter *Pickles*].

[87] *Pickles* (1895), [1895] A.C. 587 at 589.

[88] *Ibid.*

Chasemore and *Pickles* collectively show that the English common law courts were unwilling to limit rights to percolating ground water because of the then unknowable nature of the resource. Judges in Australia, the United States, and Canada adopted this same line of reasoning.[90] But as the next section shows, courts modified or abrogated the rule of capture to guard against the harsh results produced by the English cases.

C. American Doctrine of Reasonable Use

Several American courts adopted the rule of capture following the *Chasemore* decision.[91] In a classic opinion from this era, the Ohio Supreme Court declared that:

> The existence, origin, movement, and course of such [ground] waters, and the causes which govern and direct their movements, are so secret, occult and concealed that an attempt to administer any set of legal rules in respect to them would be involved in helpless uncertainty, and would be, therefore, practically impossible.[92]

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[89] *Ibid.* at 598. One has good reason to doubt whether any common-law court would follow this decision today, for Pickles' conduct seems to be a clear case of an "abuse of rights". See *Gagnon* v. *French Lick Springs Hotel Co.*, 72 N.E. 849 at 851-852 (Ind. 1904).

[90] See *e.g. Schneider* v. *Town of Olds* (1970), 8 D.L.R. (3d) 680 (Alta. S.C.T.D.); *Mayor of Perth* v. *Halle* (1911), 13 C.L.R. 393 (Aus. H.C.); *Westmoreland Cambria Natural Gas Co.* v. *Dewitt*, 18 A. 724 (Pa. 1899).

[91] For a list of such cases see S.C. Weil, *Water Rights in the Western States*, vol. 2, 3d ed. (San Francisco: Bancroft-Whitney Co., 1911) at 972 n.10 [hereinafter Weil].

[92] *Frazier* v. *Brown*, 12 Ohio 294 at 311 (1861).

However, whatever reservations such judges might have had about the usefulness of hydrogeology, several American courts wanted to protect the reciprocal rights of ground water users and encourage the use of ground water for nondomestic purposes.[93] Judges therefore considered whether the rule of capture should be expressly modified to allow only the "reasonable" use of ground water.[94] It was not uncommon to revise English legal doctrine to achieve such ends. American courts had previously modified traditional riparian theory to enable upstream riparians to make reasonable use of surface water.[95] This approach, known as the "American rule of reasonable use," prevented downstream riparians from bringing a successful claim against upstream users who were putting water to reasonable use and did not materially diminish downstream flow.[96] An advantage of the American rule was that it facilitated greater user of surface water for irrigation and industry while offering some security of title in water rights.[97] Judges applied the American rule of reasonable use to ground water for this very reason.

In *Forbell* v. *City of New York*,[98] the New York Court of Appeal applied the American rule of reasonable use to ground water. On facts similar to *Chasemore*, the court affirmed the right of a ground water user to withdraw all the water under his own land, even if this caused injury to neighbouring landowners.[99] However, unlike the English courts, *Forbell* limited one's right of ground water abstraction to only reasonable and beneficial uses.[100] The court held that abstracting ground water for "export" off the well owner's land was not a beneficial use if it interfered with a neighbouring landowner's water supply.[101] Supplying ground water to persons off one's land would only be permitted if neighbouring users did not suffer any adverse consequences.[102] In this way the American rule protected a mill owner's riparian rights to stream water as against a ground water exporter.[103] Additionally, the logical extension of the reasonable use rule guarded against the *Pickles* result, for the malicious use of water would be neither a reasonable nor a beneficial use.[104]

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[93] See *e.g. Bassett* v. *Salisbury Mfg. Co.*, 43 N.H. 569 (1862).

[94] *Ibid.*

[95] See *Red River Roller Mills* v. *Wright*, 15 N.W. 167 at 169 (Minn. 1883) (listing factors that help determine what is or is not a reasonable use of stream water).

[96] Meyers, *supra* note 68 at 118.

[97] See W. Goldfarb, *Water Law*, 2d ed. (Chelsea, Mich.: Lewis, 1988) at 23.

[98] 58 N.E. 644 (N.Y. 1900).

Although the American rule of reasonable use required ground water users to put their water to a beneficial use, it did nothing to ensure that available ground water was shared fairly amongst overlying landowners.[105] So when the chronically water short State of California abrogated the rule of capture, it engrafted a principle of equitable water sharing onto the American rule of reasonable use. The result was a new doctrine—the doctrine of correlative rights.

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[99] *Ibid.*

[100] *Ibid.*

[101] *Ibid.*

[102] *Ibid.*

[103] *Ibid.*

[104] See *Gagnon* v. *French Lick Springs Hotel Co.*, 72 N.E. 849 (Ind. 1904).

[105] Section 858 of the Restatement of Torts (Second) has modified the American reasonable use rule to add "flexibility to the types of beneficial uses that can be made of groundwater by discarding the

D. Doctrine of Correlative Rights

The doctrine of correlative rights emerged from the seminal California case of *Katz* v. *Walkinshaw*.[106] The facts of the case, as in *Chasemore* and *Forbell*, involved a landowner who exported ground water from his land to the detriment of a neighbouring water user.[107] The court rejected the rule of capture because the environmental conditions in

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constraint of the on-tract limitation of the American common law rule, thereby increasing benefits that can be derived from the resource." Sax et al., *supra* note 47 at 384. Section 858 provides:

> (1) A proprietor of land or his grantee who withdraws ground water from the land and uses it for a beneficial purpose is not subject to liability for interference with the use of the water by another, unless
>
> (a) the withdrawal of ground water unreasonably causes harm to a proprietor of neighboring land through lowering the water table or reducing artesian pressure,
>
> (b) the withdrawal of ground water exceeds the proprietor's reasonable share of the annual supply or total store of ground water, or
>
> (c) the withdrawal of ground water has a direct and substantial effect upon a watercourse or lake and unreasonably causes harm to a person entitled to the use of its water.
>
> (2) The determination of liability under clauses (a), (b) and (c) of Subsection (1) is governed by the principles stated in sections 850 to 857.

Section 858 extends a remedy not available under the American reasonable use rule when, for example, a small off-tract ground water abstractor has his or her water supply interfered with by the subsequent entry of an overlying landowner who pumps large amounts of water. *Ibid.*

[106] 70 P. 663 (Ca. 1902). Justice Temple first decided the case in 1902. After the death of Justice Temple, Justice Shaw affirmed the case on rehearing. *Katz* v. *Walkinshaw*, 74 P. 766 (Ca. 1903) [hereinafter *Katz*].

[107] *Ibid.*

California at that time were "so radically opposite to those prevailing where the doctrine arose."[108] Instead, the court endorsed the American rule of reasonable use, but with an important caveat—that the rights of each landowner are correlative with the rights of other landowners overlying the same ground water supply.[109]

The doctrine of correlative rights is similar to the American rule of reasonable use in that it protects overlying landowners from injury caused by the export of water to nonoverlying tracts. Both doctrines do not allow ground water exports to off-tract users unless all overlying landowners' reasonable uses are first met. However, the doctrine of correlative rights goes further than the American rule: it also regulates the reasonable use of overlying landowners as amongst themselves. This means that a court can apportion ground water between overlying landowners "by giving to each a fair and just proportion."[110] Although the *Katz* opinion left open the question of what was a fair and just proportion, it has been decided that it is "fair" to allocate ground water on a "first come, first served" basis.[111]

In times of shortage though, ground water will not be allocated on a first come, first served basis under the doctrine of correlative rights. Instead, all overlying landowners must "share the shortage."[112] A shortage could thus be apportioned by allocating ground water proportionate to each landowner's: (1) amount of land overlying the ground water supply; or (2) historical water use over a given period of time. California adopted the latter option, for in *City of Pasadena* v. *City of Alhambra*[113] the California Supreme Court allocated the safe annual yield of an aquifer on the basis of each overlying landowner's minimum annual use for the five years preceding the onset of the shortage.[114] As such, two limitations were imposed on ground water use: a historic limitation on each ground water user, and a collective limitation on all users to not exceed the safe annual yield of an aquifer.

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[108] *Ibid.*

[109] *Ibid.*

[110] *Ibid.*

[111] See Tarlock, *supra* note 52 c.4 at 17.

Ironically, California's legal efforts often prompted waste rather than conservation of ground water. Because ground water is allocated on a first-come, first-serve basis and shortages are shared by *all* users, the correlative rights doctrine created a virtual "race to the pumphouse". Those who were able to abstract more water before the onset of a shortage were rewarded for their wasteful efforts because past use qualified them for a higher allocation of water later in times of shortage. California ground water users were, in effect, given an economic incentive to speed up the onset of overdraft conditions rather than conserve water for the future. The race to the pumphouse undermined any consideration of the competing merits of historic ground water use by different users for different purposes.

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[112] See E.H. Hanks & J.L. Hanks, "The Law of Water in New Jersey: Groundwater" (1970) 24 Rutgers L. Rev. 621, at 638-639 (indicating that flexible rules, applied on a case-by-case basis, determine what is a fair share of a shortage).

[113] 207 P.2d 17 (Ca. 1949) [hereinafter *Alhambra*].

[114] *Alhambra*, 207 P.2d 17.

Today California and a few other states follow the doctrine of correlative rights.[115] Most jurisdictions that do not to follow this doctrine do so because it is expensive and time consuming for administrators to calculate proportionate ground water interests.[116] Several of the arid and semi-arid states and provinces in North America have chosen not to follow the doctrine of correlative rights. Instead, these jurisdictions use the doctrine of prior appropriation to regulate their ground water use.

E. Doctrine of Prior Appropriation

As with the American rule of reasonable use, the doctrine of prior appropriation first developed to allocate surface water. In particular, the California Gold Rush of 1848 created the need for this new surface water doctrine.[117] Gold mining required extensive amounts of water which the riparian system could not provide.[118] Courts resolved this problem by allocating water in the same way as mining lands—"first in time, first in right."[119] Water users thus acquired priority according to the time they first made beneficial use of the resource.[120] The amount of water that an appropriator could divert was generally limited only by the rights of those with a higher priority in time,[121] and the physical capacity of the appropriator's works. Appropriators could, however, lose their appropriative right for acts constituting the abandonment,[122] forfeiture,[123] or wastage of water.[124] In times of water shortage, the principle of priority in time resulted in closing the headgates of appropriators in reverse chronological order of first use.[125]

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[115] See Tarlock, *supra* note 52 c.4 at 19 (reporting that Arkansas, Delaware, Minnesota, Missouri, Nebraska, and New Jersey follow the doctrine of correlative rights).

[116] Alston, *supra* note 48 at 51. Alston also suggests that the adoption of the doctrine of correlative rights is further deterred because: (1) "States which have rejected the riparian doctrine in relation to surface streams would have no reasonable basis for adopting a doctrine of correlative rights for percolating groundwater;" and (2) "The doctrine offers little security to potential users who are unable to estimate long range water supply and takes no account of the relative values of different uses in the community." *Ibid.*

[117] Meyers et al., *supra* note 68 at 240.

[118] 1 Weil, *supra* note 91 at 74.

New Mexico was the first state to apply the doctrine of prior appropriation to ground water. This doctrine "had been followed 'by custom and court declaration for many years before it found expression in the statutes. It was stated in the surface-water codes of 1905 and 1907, in the State Constitution in 1911, and in the groundwater statutes of 1927 and 1931.'"[126] Prior appropriation jurisdictions generally use a licensing or permit system to regulate the withdrawal of both surface and ground water.[127] Licences are granted if the region's water administrator is satisfied that there is sufficient water available. Once a licence is issued the appropriator may use as much ground water as she wishes not exceeding the permit amount. A ground water licence is limited by the same principles as surface water licences. Thus, "senior" ground water licensees have priority over "junior" licensees during times of water shortage.[128] Some appropriators, nevertheless, do not have to acquire a ground water licence. Domestic users are often exempted from licensing requirements.[129]

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[119] See *Irwin* v. *Phillips*, 5 Cal. 140 (Cal. 1855) (establishing principle of prior appropriation). See also *Coffin* v. *Left Hand Ditch Co.*, 6 Colo. 443 (Colo. 1882) [hereinafter *Coffin*].

[120] See *Ophir Silver Mining Co.* v. *Carpenter*, 4 Nev. 534 (Nev. 1869) which applied the "relation back" doctrine for calculating priority in time. "When any work is necessary to be done to complete the appropriation, the law gives the claimant a reasonable time within which to do it; and although the appropriation is not deemed complete until the actual diversion or use of the water, still if such work be prosecuted with reasonable diligence, the right relates to the time when the first step was taken to secure it." *Ibid.*

[121] See *e.g. Parshall* v. *Cowper*, 143 P. 302 (Wyo. 1914).

[122] See *e.g. Sears* v. *Berryman*, 623 P.2d 455 (Idaho 1981).

[123] See *e.g. Rencken* v. *Young*, 711 P.2d 954 (1985).

[124] See *e.g. A-B Cattle Co.* v. *United States*, 589 P. 57 (Colo. 1978). Tarlock notes that waste is "not a rigorous standard because [it] has historically been judged by irrigation customs in the community. This is a generous standard because it defines water rights by the lowest common denominator and makes it difficult to limit the use of water." Tarlock, *supra* note 52 c.5 at 81.

[125] See Sax et al., *supra* note 47 at 138.

Prior appropriation offered one major advantage over the rule of capture and the doctrines of reasonable use and correlative rights: it allocated water solely on the basis of priority in time. Unlike the other doctrines, appropriative water rights were not predicated on ownership of land adjacent to a watercourse or land overlying a ground water aquifer. This approach met the social needs of the day, for it allowed landowners to irrigate nonriparian lands and make them suitable for agriculture.[130] Increased agricultural activity, in turn, promoted the settlement of the West.[131] Because agriculture was also extremely important in the prairie provinces at the turn of the century, the Dominion Government jettisoned common law riparianism in favour of a statutory framework based on the doctrine of prior appropriation. This framework, known in Alberta as the doctrine of prior allocation, was first applied to surface waters. It has since been applied to ground water and remains in effect today.

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[126] J.R. Chalmers, *Southwestern Groundwater Law: A Textual and Bibliographic Interpretation*, Arid Lands Resource Information Paper, No. 4 (Tucson: University of Arizona, 1974) at 73 (quoting 1972 Biennial Report of the New Mexico State Engineer in charge of water).

[127] See generally *ibid.* at 35-104 (detailing statutory licensing systems of the Southwestern states).

[128] As will be discussed in Chapter Three, it is a difficult task to enforce priorities with respect to ground water. This is so because it is difficult to prove a causal nexus between the junior appropriator's use and the adverse affect on the senior appropriator's well. A further complication is the fact that rarely is a senior appropriator deprived of all her water. Instead, senior appropriators are usually faced with increased pumping costs.

[129] See *e.g.* *Parker* v. *Wallentine*, 650 P.2d 648 (Idaho 1982).

F. The Development of Water Law in Alberta

As in England and the western United States, western Canada developed its surface water laws before its ground water laws. Ground water was, in fact, not brought under regulation in Alberta until 1962.[132] Before discussing Alberta's ground water law, it is once again necessary to provide a brief description of the law applicable to surface waters.[133]

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[130] *Coffin*, 6 Colo. 443 . As Justice Helm stated in the *Coffin* opinion, where the "climate is dry, and the soil, when moistened only by the usual rainfall, is arid and unproductive; except in a few favored sections, artificial irrigation for agriculture is an absolute necessity." *Ibid.*

[131] *Ibid.*

[132] See *Water Resources Act*, R.S.A. 1980, c. W-5, as amended, s. 1(v) (defining water as "all water on or under the surface of the ground") [hereinafter *Water Resources Act*]. Ground water has still not been included in British Columbia's water rights legislation. British Columbia Ministry of Environment, Lands and Parks, "1 - Groundwater Management" in *Stewardship of the Water* (Province of British Columbia, 1993) at 6.

The Prairies followed the doctrine of riparian rights until 1894, when the Dominion Government enacted the *North-West Irrigation Act*.[134] This Act gave the federal government the power to allocate water according to the principle of "first in time, first in right." The federal government adopted the principle of priority in time for the same reasons as the western United States—to facilitate agriculture and encourage settlement. However, although the *North-West Irrigation Act* incorporated the American principle of priority in time, it did not adopt prior appropriation in the strictest sense.[135] Those wishing to appropriate water had to apply to the Dominion Crown to obtain a water licence. Appropriators acquired priority in time as of the date their licence application was filed. Although a licensing system was also used in American prior appropriation jurisdictions, these states calculated priority from the date an appropriator first put water to beneficial use instead of the date the licence was filed.[136] Percy has pointed out this difference,[137] which is why he describes the *North-West Irrigation Act* as a "prior allocation" (not prior appropriation) statute.

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[133] For a detailed discussion of the law of surface water rights in Alberta see D. R. Percy, "Water Rights in Alberta" (1977) 15 Alta. L. Rev. 142 [hereinafter "Water Rights"]. See also Percy, *Framework*, *supra* note 41. The reader should consult Professor Percy's works for a more detailed description of western Canadian water law than this thesis is able to provide.

[134] *The North-West Irrigation Act*, S.C. 1894, c.30.

[135] See Percy, *Framework*, *supra* note 43 at 13-14.

[136] *Supra* note 120 and accompanying text.

[137] Percy, *Framework*, *supra* note 43 at 13-14.

When Alberta and Saskatchewan became provinces in 1905 the Dominion Crown owned all ungranted natural resources and issued all water licences.[138] In 1930 the federal government had transferred all ungranted natural resources in the region to the western provinces.[139] A 1938 amendment to the transfer agreement clarified that the provinces owned all ungranted rights in water.[140] Crown ownership of the water in Alberta is now entrenched in Alberta's *Water Resources Act*.[141]

1. *The Alberta* Water Resources Act

Like the *North-West Irrigation Act*, the Alberta *Water Resources Act* (hereinafter "the Act") allocates water by prior allocation. Anyone can apply for a licence to appropriate water under the Act, although domestic users of both surface and ground water are allowed to appropriate water without a licence for domestic purposes as defined by the Act.[142] If an applicant for a licence submits an application in the correct form, the Minister of Environment, who is charged with administering the Act, may issue a licence subject to any terms and conditions.[143] Notwithstanding the Minister's discretionary power to include terms and conditions, licences are traditionally issued for an indefinite term. Licence approval turns on the question of whether there is sufficient water available to satisfy applicant's proposed use. As a precondition to a full water licence, the Minister will often require an applicant for ground water to survey and explore the area of proposed water use. When such an investigation is required the applicant will be given a temporary water exploration permit.[144] The purpose of the permit is to demonstrate to the Minister that there is sufficient water available and that the proposed water use will not negatively affect the area's water supply. Exploration permits are now issued to all applicants seeking a licence for ground water abstraction.[145]

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[138] *The Alberta Act*, S.C. 1905, c.3 s.21; *The Saskatchewan Act*, S.C. 1905, c.42 s.21.

[139] *Constitution Act, 1930*, 20-21 Geo. V, c.26 [U.K.], schedule 2, s.1 (containing text of 1930 *Natural Resources Transfer Agreements*).

[140] *The Natural Resources Transfer (Amendment) Act, 1938*, S.C. 1938, c.36.

[141] *Water Resources Act*, s.2(1).

[142] *Water Resources Act*, s.2(2).

[143] See *Water Resources Act*, s.11(1) (specifying types of licences and permits available).

Applicants usually receive interim water licences before being granted full water licences.[146] Interim licences are good for a one year period, but may be extended beyond that time.[147] Such licences are issued when the applicant must construct works necessary for the diversion of water. As such, interim licences cover the period in between the commencement and completion of works necessary for the diversion of water. Once the works are constructed in accordance with the applicant's approved plans, the Minister will cancel the interim licence and replace it with a permanent licence. Provided the licensee has constructed the works with reasonable diligence, the priority of the full licence will be calculated from the original date of the licence application, not as of the date of the interim licence.

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[144] *Water Resources Act*, s.15(2).

[145] *Water Resources Act*, s.15(9). The Act provides that "no person is entitled to apply or a licence . . . to divert groundwater unless he has . . . obtained and exploration permit . . . [and] has complied with the exploration permit . . . ." *Ibid.*

[146] *Water Resources Act*, s.18(1).

[147] *Water Resources Act*, s.18(2).

If two licence applications are filed on the same date, a statutory table determines the relative priorities of the licences.[148] This table fixes a preference for domestic water uses, followed by municipal, agricultural, industrial, water power, and other uses. In a related provision, the Act allows a person to acquire another's lower priority water use either by voluntary transfer or by expropriation.[149] This related provision allows a municipality, for example, to acquire all or part of the lower priority water use of an irrigator, but not *vice versa*.[150] However, the importance of this transfer provision, the fixed list of priorities, and the overall statutory framework of prior approval has been de-emphasised by administrative policy. As Percy observed:

> In practice, the priorities established by the legislation are rarely enforced. In times of shortage, the available supply of water has generally been rationed amongst licensees, who are encouraged to make proportionate reductions in their use. . . . [Moreover,] there is no evidence that [the procedure for transferring water] has ever been employed in practice.[151]

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[148] *Water Resources Act*, s.11(1)(a)-(e).

[149] *Water Resources Act*, s.11(4).

[150] D. R. Percy, *The Regulation of Ground Water in Alberta* (Edmonton: Environmental Law Centre, 1987) at 7 [hereinafter *Ground Water*]. Apart from the unused and limited opportunity to transfer water rights, the Act does not otherwise allow a licensee to sell his or her water allocation to another. As will be shown in later chapters, this limit on transferability of rights is detrimental to allocating water to its most beneficial use, and complicates the problem of managing scarce ground water resources. See also Percy, *Framework*, *supra* note 43 at 43.

[151] Percy, *Ground Water*, *supra* note 150 at 7.

Accompanying the trend not to enforce statutory priorities is the tendency of the Minister to use greater administrative discretion in allocating water rights. The treatment of ground water under the Act provides a vivid example of this tendency.

a. Allocation of Ground Water Under the Water Resources Act

It will be recalled that ground water was brought under the Act in 1962, when the definition of the types of "water" was amended to include ground water.[152] The effect of this change arguably vested in the Crown all ungranted ground water resources.[153] On the one hand, this amendment appears to be perfectly legitimate because the 1930 transfer agreement and the 1938 amendment thereto similarly vested the ownership of all natural resources in the Crown.[154] On the other hand, this action seems improper because, consistent with the common law rule of *ad coelum et usque ad inferos*, one can argue that ground water is a qualified property interest of overlying landowners. Viewed in this light, the Crown's decision to bring ground water within the Act can be characterized as expropriation of the resource without compensation.[155] As of yet, however, no one has instituted a legal proceeding to challenge the government on these grounds.[156]

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[152] See *supra* note 132 and accompanying text.

[153] Alternatively, the change may not have vested *ownership* of ground water in the Crown, but only conditioned the diversion of ground water on the successful application for a water licence.

[154] See *supra* note 139 and accompanying text.

[155] See Percy, *Ground Water, supra* note 150 at 9. The expropriation of ground water in this way gives rise to the argument that the statute could not have been intended to deprive landowners' of their vested interest in ground water. *Ibid.*

After 1962, all nondomestic users of ground water were required to obtain a licence before abstracting the resource. As a result of what was probably poor publicity of the amendment and under-enforcement of the licensing requirement, many ground water users remained unlicensed thereafter.[157] Accordingly, in 1971 the Department of Environment allowed nondomestic ground water users to register their wells and obtain licences with priorities relating back to the date each well was brought into production.[158] Ground water users could obtain licences under this extraordinary procedure up until June 30, 1973, after which time the priority of all ground water uses was supposed to only be calculated from the date of licence application. The opportunity to register existing wells with this "grandfathering" provision was, however, extended until June 30, 1978.[159] "It was thus not until 1978 that ground water was fully brought under the Act and treated on the same basis as surface water, and even today the consequences of this integration may not be widely appreciated."[160]

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[156] One must wonder how effective such a legal challenge would be, particularly in light of the fact that Albertans have acquiesced to the licensing of ground water for more than thirty years.

[157] Percy, *Ground Water*, *supra* note 150 at 8.

[158] *An Act to Amend the Water Resources Act*, S.A. 1971, c.113, s.14.

[159] S.A. 1975 (2d sess.) c.88, s.42.

[160] Percy, *Ground Water*, *supra* note 150 at 9.

As a result of bringing ground water under the Act, unlicensed domestic users now, in both a legal and physical sense, compete with licensed users for the same ground water. At first blush this would seem to be the same type of situation encountered between unlicensed domestic surface water users and licensees. Domestic surface water users can rely on their common law riparian rights to ensure that they are not deprived of sufficient water by upstream licensees.[161] Yet although the Act also allows domestic users to abstract ground water without a licence, the common law does not offer any security of water supply to such users. This is so because a domestic ground water user in Alberta must rely on the common law rule of capture to acquire ground water. As previously shown by *Acton* and other cases, this common law right does not secure a right to any particular amount of water.[162] Landowners are simply allowed to abstract as much ground water as they can use without infringing upon each other's common law rights. So while domestic surface water users have protected water rights as a result of the doctrine of riparian rights, ground water users are offered no similar protection through the common law rule of capture. Thus, the problem with integrating the common law of ground water with the *Water Resources Act* is that a new licensed user may move into an area, begin abstracting ground water, and totally deprive a landowner of his or her domestic ground water supply without infringing in law on that individual's water rights.[163]

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[161] Percy, *Framework*, *supra* note 43 at [illegible].

[162] See *supra* note 70 and accompanying text.

[163] Professor Percy was the first to comment on this problem in legal literature. See Percy, *Ground Water*, *supra* note 150 at 10-11.

This problem was brought to life in *Schneider* v. *Town of Olds*[164]—the only reported case interpreting ground water rights under the *Water Resources Act*. In *Schneider*, Chief Justice Milvain of the Alberta Supreme Court, Trial Division, was presented with the question of whether the plaintiff, a domestic ground water user, could obtain compensation for increased pumping costs resulting from low levels of water in his well.[165] Plaintiff contended that the low water levels were caused by a well on an adjoining piece of land owned by the defendant, the Town of Olds.[166] The Town did not have a licence for this well.[167] Notwithstanding, Chief Justice Milvain declined to enjoin the Town from further pumping because the plaintiff only challenged the defendant's interference with his water supply, not the fact that the Town did not hold a licence.[168] According to the court, the only thing the Town did wrong was fail to apply for a licence.[169] Although plaintiff could stop the Town from abstracting water in a proceeding "properly contemplated" to challenge the Town's failure to obtain a licence, the court indicated that plaintiff's status as a domestic water user was an insufficient to limit the use of a licensee.[170] If the Town subsequently applied for and received a licence, the plaintiff would have no valid complaint in any regard. Thus, under the current state of the law:

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[164] (1970), 8 D.L.R. (3d) 680 (Alta. S.C.T.D.) [hereinafter *Schneider*].

[165] *Schneider* (1970), 8 D.L.R. (3d) at 681.

[166] *Ibid.*

[167] *Ibid.* at 682.

[168] *Ibid.*

[169] See *ibid.* at 683.

[170] *Ibid.* at 682.

> The legal position of unlicensed domestic well owners in Alberta is therefore precarious. They enjoy no legal protection whatsoever and would be wise to insist upon obtaining a licence under the Act, even though it is not strictly required. . . . Despite the compelling logic of this position, the Department [of Environment] has long advised that it is not necessary for domestic well owners to obtain licences under the Act, possibly relying on the false analogy of the position of riparian owners.[171]

Further complicating the position of ground water users in Alberta is the emerging trend of Alberta Environmental Protection to use certain administrative policies arguably outside the range of its statutory authority to allocate ground water.

b. Administrative Discretion and the Allocation of Ground Water Resources

Integrating ground water into an Act whose purpose was to facilitate irrigation and agriculture resulted in the need for new water policies. These new water policies were a function of administrative decision-making, not legislative action. It is understandable that this change coincided with greater water use by municipalities, industry, and water power projects, because new policies had to be implemented to secure water rights for these purposes. Environmental concerns similarly created a need for new administrative policies. Increasing the role of administrative discretion was thus the only way that the Act could be modified without legislative amendment to promote a wider variety of water uses. But as the following material shows, this shift to administrative policy-making has not been without its legal costs.

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[171] Percy, *Ground Water, supra* note 150 at 11.

i. Allocating Ground Water for Oilfield Injection Purposes

Although the Minister may legitimately exercise discretion in administering the Act, the Minister's actions are *ultra vires* when they adversely affect substantive rights guaranteed by the Act.[172] Allocation decisions involving the use of potable ground water for oilfield injection purposes illustrate this problem.

As previously described, the Act primarily uses the principle of priority in time to prefer one use over another in times of water shortage. Except when two licence applications are received on the same date, the Minister has no statutory authorization to prefer one ground water use over another.[173] Applications for the use of potable ground water for oilfield injection purposes have not been judged according to this principle. Instead, the Minister has announced a policy to give continuing protection to existing and future domestic and agricultural ground water users over oilfield injection.[174] This attempt to protect future domestic or agricultural ground water users is clearly contrary to the priority accorded to senior licensees under the Act. No matter how socially desirable it might be to protect future domestic users against licensed users abstracting water for oilfield injection purposes, the Act currently leaves no room for such *ad hoc* preferences.[175]

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[172] Percy, *Ground Water, supra* note 150 at 13 ("the exercise of discretion can supplement the provisions of the *Water Resources Act* but cannot contradict them, because the rules established by the Legislature must prevail if they conflict with decisions taken by officials.").

[173] If two applications are received on the same date, the statutory list of priority determines which has priority. See *Water Resources Act*, s. 11(1)(a)-(e).

[174] A.R. Lucas, *Security of Title in Canadian Water Rights* (Calgary: Canadian Institute o Resources Law, 1990) at 74 n.272 [hereinafter Lucas, *Security*] (citing Alberta, Dept. of Environment, "Ground Water Allocation Policy for Oilfield Injection Purposes" (Edmonton: March 1990)).

The administrative approach to allocating ground water is beset by two more problems, both of which involve the principle of priority in time. First, the Minister's final "Ground Water Allocation Policy for Oilfield Injection Purposes" limits oilfield-injection users to no more than half of the long-term yield of an aquifer.[176] This fixed limit is applied to all applicants. Such a limit is outside the authority of the Act if it is designed to reserve to future users a certain quantity of ground water,[177] because only the Lieutenant Governor in Council may make such a reservation.[178] Second, the fixed ground water quantity limit is subject to challenge because it deprives applicants of the opportunity to have their applications reviewed on an individualized basis.[179] Such a blanket approach may run afoul of the rule in administrative law that public officials may not fetter their discretion by establishing pre-existing policies.[180]

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[175] Lucas, *Security, supra* note 174 at 82. Accord Percy, *Ground Water, supra* note 148 at 16.

[176] Lucas, *Security, supra* note 174 at 73 (referring to provisions of: Alberta, Dept. of Environment, "Ground Water Allocation Policy for Oilfield Injection Purposes" (Edmonton: March 1990)).

[177] See *supra* note 175 and accompanying text.

[178] The Lieutenant Governor in Council may reserve unallocated water, see *Water Resources Act*, s. 12(1), and may designate or redefine priorities of uses during emergencies see *Water Resources Act*, s. 13(1). Outside of these broad powers, the Act does not have a procedure for conditioning the grant of licences on the protection of undetermined future uses.

[179] Lucas, *Security, supra* note 174 at 79.

[180] Lucas, *Security, supra* note 174 at 73; Percy, *Ground Water, supra* note 150 at 16.

Finally, the Controller of water resources now frequently issues temporary ground water permits instead of licences.[181] Unlike a licensee, the holder of a temporary permit is subject to having his or her authorization reviewed periodically. The effect of this review is to give the permit holder a less secure interest in water.[182] Such administrative modification of water rights finds limited support in the Act. Usually the Minister may only modify or cancel water rights for abandonment, forfeiture, failure to properly construct works, pay fines, and for other like purposes.[183] The Controller has no such authority to modify water rights if the modification conflicts with the principle of priority in time. Lucas thus concludes that:

> potential oilfield injection water users have the right under [the Act] to apply for licences, as opposed to temporary permits. Applicants are then entitled to have their applications fairly and objectively considered by the Controller. The Controller has no authority to adopt a blanket policy of rejecting all such applications or to consider only temporary permit applications. It would amount to failure to make the decision required on licence applications, and a loss of jurisdiction.[184]

Due to the shortcomings of the Act and its administration, Alberta recently revised its water rights legislation.[185] In July 1995 the Water Management Review Committee released a report on this subject.[186] This report was then translated into draft legislation,[187] which was ultimately introduced in the Legislature (with minor revisions) as Bill 51[188] or the Alberta "*Water Act*". The *Water Act* passed the Legislature and was assented to on September 3, 1996.[189] As of the writing of this thesis, the *Water Act* was not yet proclaimed in force (see Author's Note, *supra*, explaining that the *Water Act* was not in force during the writing of this thesis and stating that the Act will come into force on January 1, 1999). The final section of this chapter briefly outlines those provisions in the *Water Act*, which once proclaimed, will affect ground water users in Alberta.

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[181] Lucas, *Security, supra* note 174 at 73 (referring to provisions of: Alberta, Dept. of Environment, "Ground Water Allocation Policy for Oilfield Injection Purposes" (Edmonton: March 1990)).

[182] Lucas, *Security, supra* note 174 at 73; Percy, *Ground Water, supra* note 148 at 16. Accord Petro-Canada Inc., *The Law Related To Ground Water Aquifers and Competing Uses in the Province of Alberta* (Edmonton: Environmental Law Centre, 1985) at 21.

[183] See *Water Resources Act*, s. 51(1) (cancellation of licence for waste).

[184] Lucas, *Security, supra* note 174 at 76.

[185] For a discussion of the legislative changes to Alberta's water laws see D.R. Percy, "Seventy-Five Years of Alberta Water Law: Maturity, Demise & Rebirth" (1996), 35 Alta. L. Rev. 221 [hereinafter

2. *Towards Reform: Alberta's New* Water Act

The *Water Act* retains the core of the *Water Resources Act*'s prior allocation scheme. However, unlike the old Act, the *Water Act* gives the Minister explicit authority to assume a larger policy-making and planning role. Section 7(1) of the *Water Act* requires the Minister to "establish a framework for water management planning for the Province within 3 years after the coming into force of this Act." The planning framework mandated by s. 7(1) must include "a strategy for the protection of the aquatic

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Percy, "Seventy-Five Years".]

[186] WMRC Report, *supra* note 37.

[187] Water Management Review Committee, "Discussion Draft Water Conservation Management Act" (Edmonton: 1995).

[188] Bill 51, *Water Act*, 3d Sess., 23d Leg., Alberta, 1995.

[189] *Water Act*, S.A. 1996, c. W-3.5 [hereinafter *Water Act*].

environment" and "may" include:

> (a) water management principles,
> (b) the geographical limits or boundaries within which water management planning is to be carried out in the Province, including limits or boundaries for the development of ~~strategic and~~ operational plans,
> (c) criteria for establishing the order in which water management plans are to be developed,
> (d) an outline of the processes for developing, implementing, reviewing and revising water management plans, including opportunities for local and regional involvement,
> (e) matters relating to integration of water management planning with land and other resources, and
> (f) matters relating to the development of water conservation objectives.[190]

Once the Minister establishes a water management planning framework, he or she "may require a water management plan to be developed by the Director or another person."[191]

As s. 9(2) of the *Water Act* explains:

> (2) the Director or other person developing a water management plan
> (a) may adopt an integrated approach to planning with respect to water, land and other resources;
> (b) may co-operate with
> (i) any persons,
> (ii) local authorities,
> (iii) Government agencies and other Government departments, and
> (iv) the governments and government agencies of other jurisdictions;
> (c) may, with the consent of the Minister, carry out any studies that the Director or other person considers appropriate;
> (d) may consider any information, documents or other water and land management plans;
> (e) must follow the framework for water management planning established under this Division;
> (f) must engage in public consultation that the Minister considers appropriate during the development of the water management plan.

Section 164 of the *Water Act* further provides:

> The Director may establish water management areas for the purposes of
> (a) administering priority to divert water,

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[190] *Water Act*, s. 7(2).

[191] *Water Act*, s. 9(1).

(b) groundwater management,
(c) temporarily assigning water under section 33,
(d) directing that the diversion of water for household purposes cease,
(e) directing that applications for licences are not to be accepted, and
(f) any other matters specified in the regulations.

These provisions, in combination with others allowing the development of water management guidelines,[192] conservation objectives[193] and designation of water management planning areas,[194] legitimizes the Minister's policy-making function in areas like ground water allocation for oilfield injection purposes. The *Water Act* thus makes it theoretically possible for the Minister, through the Director or persons with delegated authority, to develop and implement individualized ground water management plans.

Additionally, the *Water Act* gives unlicensed domestic ground water users priority as against licensees by preferring domestic uses to licensed uses.[195] Providing this type of security of title in domestic ground water guards against the result of *Schneider* v. *Town of Olds*, where a pre-existing domestic ground water user was left unprotected against interference from a subsequently drilled municipal ground water well. To achieve this end the *Water Act* provides that: "A person who diverts water [for household purposes under section 21] has priority over a person who is entitled to divert water ... pursuant to an approval, licence or registration ...".[196]

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[192] *Water Act*, s. 14.

[193] *Water Act*, s. 15.

[194] *Water Act*, s. 10.

[195] *Water Act*, ss. 21, 27.

Subject to the foregoing limitation, licences issued before the passage of the draft legislation will continue in force.[197] New licences will only be issued for a specific period of time,[198] but will be renewable.[199] Where no water is available or where a licence application is not in the public interest, the Minister may not accept applications for licences.[200] Persons unable to acquire a new water licence may avail themselves of new, much anticipated provisions allowing the transfer of water rights.[201] Any licensee can apply to transfer all or part of his or her licensed water entitlement.[202] An application to transfer water can be considered only if transfers have been authorized for the area by an approved water management plan, or if there is no plan, by Cabinet order.[203]

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[196] *Water Act*, s. 27(b).

[197] *Water Act*, s. 18.

[198] *Water Act*, s. 51(5).

[199] *Water Act*, s. 59(1). The Minister may not renew a licence only where: it is not in the public interest; as provided by a water management plan; to meet instream need; to avoid damage to the riparian or aquatic environment; or when the water right has been abandoned. *Water Act*, s. 60.

[200] *Water Act*, s. 34.

[201] *Water Act*, ss. 81, 82.

[202] *Water Act*, s. 81(1).

[203] *Water Act*, s. 81(7).

G. Summary

This chapter has outlined the basic ground water doctrines used in Western systems of water law. Particular emphasis has been placed on the system of prior allocation used in Alberta. The illustrations in this chapter have shown that each ground water doctrine developed in response to climatic conditions and the shortcomings of the existing law. The primary aim of the doctrines described in this chapter is to secure access to ground water. However, all these doctrines, including the approach used in Alberta, suffer from the inability to allocate ground water to the most socially and economically beneficial uses. The next chapter will explain why this is necessarily so.

CHAPTER THREE

The four doctrines of Western ground water law do not necessarily allocate ground water to the most economically and socially beneficial uses. The vast number of hydrogeological, economic, social, and political conditions that exist in any given jurisdiction make each doctrine inadequate in many respects. Professor Corker wrote about these problems in 1971 when he identified several doctrinal impediments to effective ground water management.[204] The most pressing of these doctrinal impediments or "problems" are: waste; well interference; ground water mining; and non-conjunctive management of ground water and surface water resources.[205] Another problem that reduces available ground water supplies, but is outside the scope of this thesis, is ground water pollution. This chapter discusses the first four problems listed above in relation to Alberta's system of prior allocation and the prevailing doctrines of ground water law in general. It then identifies how site-specific, remedial ground water programs provide physical solutions to pressing ground water problems.

A. The Allocative Problems With Western Ground Water Law

1. Waste

Water conservation is crucial to the long-term sustainability of water resources.[206]

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[204] See Corker, *supra* note 22 at 112-126.

[205] P.K. Smith, "Coercion and Groundwater Management: Three Case Studies and a Market Approach" (1986) 16 Env. L.J. 797 at 801 [hereinafter Smith, "Coercion"].

[206] See S.J. Shupe, "Waste in Western Water Law: A Blueprint for Change" (1982) 61 Oregon L. Rev. 483 at 483-484 (remarking that inefficient and excessive water use "reduces the supply [of water]

Society can conserve water by reducing, reusing, and recycling the resource. Of these three well known options, reducing water consumption is the simplest way to increase water availability.[207] Nevertheless, most users do not conserve water. As one author has stated,

> [d]espite the predicted water crisis in the West, wasteful conveyance and irrigation practices abound. Agricultural uses of water, which account for roughly eighty-three percent of all water consumption in the United States, are especially wasteful, with less than fifty percent of the water diverted to farms actually being used by crops. Conserving this wasted water provides a potential means of satisfying the increased demand for water. In addition to increasing the supply of water to Western cities, more efficient irrigation practices would serve environmental values by preserving in-stream flows, reducing soil erosion, and preventing the runoff of pesticides into other water sources.[208]

Not unlike their Southwestern neighbours, agricultural users in Alberta divert and consume more than half of the province's surface water and roughly seventy percent of its ground water.[209] Given this similarity, it stands to reason that Alberta and the western states can substantially increase water availability by reducing wasteful water use.

Promoting more efficient water use in the agricultural sector is a good starting point

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to all sectors of the economy, and leads to the degradation of regional water quality") [hereinafter Shupe].

[207] See R. Jensen, "A New Approach to Regional Water Management" (1988) Texas Water Resources Newsletter, Vol. 13 No. 3 at 2 (arguing that water conservation is key to responsible water resource management).

[208] R.A. Pulver, Comment, "Liability Rules as a Solution to the Problem of Waste in Western Water Law: An Economic Analysis" (1988) 76 Calif. L. Rev. 671 at 671-672 [hereinafter Pulver].

[209] See D. R. Percy, *Natural Resources Seminar Materials* (Edmonton: University of Alberta, 1995) at 2 (showing that agricultural accounted for almost 60% of Alberta's surface water withdrawals and 70% of Alberta's ground water withdrawals in 1989) [hereinafter Percy, *Seminar Materials*].

for reducing waste.[210] This is not to suggest that agricultural users are the sole reason for shortages, or are the only users to waste water.[211] Municipal and industrial users also cause water shortages by using excessive quantities of water. But regardless of where the blame is allocated, waste is one of the issues has "special force on the Canadian prairies, where the water supply is highly variable, and on the average not abundant, where memories of water shortages are deeply rooted, and where the demand for water (urban, industrial, irrigation, recreational) is steadily increasing."[212]

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[210] See B.A. Maak, Note, "Water Waste—Ascertainment and Abatement" (1973) Utah L. Rev. 449 at 449-450 [hereinafter Maak]. Mr. Maak observes that:

> The inefficiency of the agricultural sector's use of water demonstrates the need to turn attention to the problem of water waste. Agriculture—the largest water consumer and waster in the United States—uses approximately one-half the nation's fresh water supply. Of that huge quantity, approximately one-half is lost before it reaches the field; of the amount reaching the field, only one-half is used for the production of plant life. Agriculture's appalling seventy-five percent water waste factor is due to such causes as evaporation, transpiration, non-beneficial water-consuming vegetation, and seepage. With present technology, the water loss due to each of these causes may be minimized or eliminated.

Ibid.

[211] To their credit, many agricultural users have upgraded their irrigation systems and diversionary works to conserve water.

[212] See D.K. Elton, "Managing the Water Resources of the Prairies" in *Water Policy for Western Canada: The Issues of the Eighties* at 137 (Calgary: University of Calgary Press, 1982). Mr. Elton notes that six phenomena make water resource management problematic: (1) the location of water is not fixed; (2) the amount of water available in any given area is subject to great variability; (3) the amount and quality of water can be greatly affected by neighboring users; (4) water is used in a number of competing ways; (5) serious human consequences arise from water shortage; and (6) "many people consider access to, and utilization of, the resource to be a right which should neither be charged for, nor denied." *Ibid.*

Canadian courts have not reported one decision on wasting ground or surface water.[213] This lack of caselaw does not mean that water users are not wasting water, for overconsumption and waste is well documented in Canada.[214] Rather, it suggests that: (a) governments rarely enforce existing statutory waste prohibitions; and (b) these prohibitions only punish especially wasteful water users. American research supports these two conclusions, for prior appropriation jurisdictions in the United States have not been able to control the problem of waste for these very same reasons.[215] It also stands to reason that these problems obtain in Alberta because this province's water legislation is primarily derived from the American theory of prior appropriation.[216]

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[213] This author's searches through September 1995 in the Canadian Abridgement and on Quicklaw Systems revealed no cases about wasting water.

[214] Karvinen et al., *supra* note 1 at 3. "Canada's water rate withdrawal during the period 1972 to 1981 increased by over 50 percent, while the population increased only 5 percent over the same period." *Ibid.*

[215] See generally Shupe, *supra* note 206 at 491. Similarly, the other doctrines of water law also do not effectively control waste. For example, the rule of capture does not punish wasteful water use. Ground water users are allowed to use any amount of ground water for any purpose, without regard for the interests of neighboring water users. Although courts in some rule of capture jurisdictions have held that the malicious waste of water is an abuse of rights, see *Gagnon* v. *French Lick Springs Hotel Co.*, 72 N.E. 849 at 851-852 (Ind. 1904) (prohibiting the defendant's future abstraction and waste of ground water for the sole purpose of harming the plaintiff), nothing prevents persons from wasting ground water on nonmalicious but frivolous activities, such as watering highways and flooding lands to attract ducks. See *Chatfield* v. *Wilson*, 28 Vt. 49 at 57-58 (Vt. 1855) (explicitly refusing to consider the defendant's motive for diverting ground water). The use of huge quantities of water for marginally productive activities is also permissible under the rule of capture. For example, a small-scale catfish farmer in the one million person, chronically water-short city of San Antonio, Texas used 25% of the city's daily water supply to circulate potable ground water through catfish tanks. See M. Lenz, "AG Opinion May Curb Water Use By Catfish Farm" *The Houston Post* (5 Nov. 1991) A10. Selfishly using or wasting such huge quantities of water is the main reason that legal commentators have called for the abrogation of Texas' rule of capture. See *e.g.* K.H. Norris, Comment, "The Stagnation of Texas Groundwater Law: A Political v. Environmental Stalemate" (1990) 22 St. Mary's L.J. 493 at 498-499.

[216] See discussion of the development of Alberta water law, *supra* Chapter Two.

In prior appropriation jurisdictions "[w]aste is usually understood as 'using' water in any way that is not considered a beneficial use either by common law or by statute."[217] The "beneficial use" requirement has two components. First, it defines the "beneficial" purposes of water use, including domestic, agricultural, industrial, municipal, recreational, and natural state uses.[218] Second, it includes a prohibition against waste.[219] The difficulty with this second component is that "waste" has been given an extremely narrow interpretation in light of customary usage.[220] Accordingly, courts generally hold that inefficient methods of abstracting, transporting, or using water are not wasteful if they conform with local custom.[221] The Montana Supreme Court reached this very conclusion in *State* ex rel. *Crowley* v. *District Court*,[222] where it held that if "'ditches and flumes are the usual and ordinary means of diverting water, parties who have made their appropriations by such means cannot be compelled to substitute [more efficient] iron pipes"[223] even if this would prevent huge losses in the conveyance of irrigation water. Commentators thus conclude that

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[217] Smith, *supra* note 205 at 802.

[218] Shupe, *supra* note 206 at 488.

[219] See Shupe, *supra* note 206 at 488.

[220] W. Goldfarb, *Water Law*, 2d ed. (Chelsea, Mich.: Lewis, 1988) at 35-36 [hereinafter Goldfarb, *Water Law*]. Professor Goldfarb states that "waste of water is a significant problem in the West, especially where irrigation is concerned." *Ibid.*

[221] See Maak, *supra* note 210 at 454 (stating that custom is the single most important factor to judges considering the question of waste). However, other lesser important factors may come into play including: (1) the reasonableness of the defendant's use in relation to the needs of another; (2) the percentage of water lost in transport; (3) the economic circumstances of the defendant and his or her financial ability to use more efficient works; and (4) the construction and maintenance of the defendant's works. See *ibid* at 452-460.

[222] 88 P.2d 23 (Mont. 1939) [hereinafter *Crowley*].

> [i]f a [water use, or method of abstraction or transportation] . . . was commonly used in a region and was operated properly, it generally was held not to be legally wasteful despite significant water losses. As construed, "beneficial use" allowed diverting enough water to accommodate both customary losses and crop consumption. Consequently, customary loss became part of the protectable water right.[224]

In the end, waste is a problem for all jurisdictions in the West because courts tend to allow customary water usage without consideration of efficiency.[225] Nothing suggests that Alberta's courts will depart from this lax standard if or when they consider the problem of waste.[226]

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[223] *Crowley*, 88 P.2d 23 at 30 (quoting J. Long, *A Treatise on the Law of Irrigation* s. 116 (2d ed. 1916)).

[224] Shupe, *supra* note 206 at 491.

[225] Similarly, the "reasonableness" requirement that defines waste in reasonable use and correlative rights jurisdictions does not encourage efficient water use. Although the notion of "reasonableness" theoretically supports a searching judicial comparison of the values of competing water uses, courts have shied away from this approach. For example, in *Tulare Irrigation District* v. *Lindsay-Strathmore Irrigation District* the Supreme Court of California announced what appeared to be a strong prohibition against waste. The court held that drowning gophers and squirrels with irrigation water is not a reasonable use of scarce water resources. *Tulare Irrigation Dist.* v. *Lindsay-Strathmore Irrigation Dist.*, 45 P.2d 972 at 997, 1007 (Ca. 1935) [hereinafter *Tulare*]. The court reached this decision not solely on the basis of custom, but by limiting "the use of customary modes of conveyance [of water] by the reasonable demands of efficiency." Maak, *supra* note 210 at 455. Nevertheless, despite the *Tulare* court's explicit reference to efficiency, subsequent courts have not followed this line of reasoning. Newer cases basically "give no attention to the reasonableness of the custom being considered" and merely consider whether the suspect water use is a customary practice. *Ibid.*

[226] There is, of course, the possibility that Alberta courts would not follow the well established and analogous American jurisprudence on waste because of its shortcomings. Although this would undoubtedly be unpopular with agricultural users, it would promote the sustainability of water resources. For Alberta courts to take a stand against waste they should equate waste with inefficient water use, not customary usage. See G.W. Pring & K.A. Tomb, "License to Waste: Legal Barriers to Conservation and Efficient Use of Water in the West" (1979) 25 Rocky Mountain Min. L. Inst. 25-1 at 25-43 to 25-44 [hereinafter Pring & Tomb]. Thus, in terms of recommendations for change:

> The most heavily favored and promising reform area is for states strictly and imaginatively to enforce the waste control mechanisms already available in their

2. Well Interference

Well interference makes withdrawing ground water expensive, difficult, and sometimes even impossible.[227] Ground water users encounter these problems when the withdrawals of one or more users diminish another's ground water supply and increase energy and pumping costs.[228] Such interference may occur when the water table is drawn down to a level near or below another's well bottom.[229] If such conditions arise it becomes difficult for ground water users to abstract water in the usual manner. But reducing the overall quantity of ground water in an aquifer is not the only cause of well interference. Another type of well interference "is caused by a cone of depression extending out from [a competing] party's well because of pumping pressure."[230] Ground

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> appropriation laws. The limiting concepts of "beneficial use," "reasonable use," "waste," and "public interest/welfare" are operative elements of the western states' laws. The vagueness which has plagued their court interpretation need not be an impediment to reasoned and reasonable administrative enforcement, given the discretion and deference customarily accorded agency expertise.

Ibid.

[227] For an excellent discussion of well interference in nontechnical language see Sax et al., *supra* note 47 at 392-398.

[228] See Percy, *Ground Water, supra* note 150 at 12 (noting that well interference is more likely to create a slower rate of flow to a well than a complete interruption of supply).

[229] See Smith, "Coercion", *supra* note 205 at 803.

[230] Smith, *supra* note 205 at 804. Professor Todd describes a cone of depression as follows:

> When a well is pumped, water is removed from the aquifer surrounding the well, and the water table or piezometric surface, depending on the type of aquifer, is lowered. The *drawdown* at a given point is the distance the water level is lowered. A *drawdown curve* shows the variation of drawdown with distance from the well . . . . In three dimensions the drawdown curve describes a conic shape known as the *cone of depression*. Also, the outer limit of the cone of depression defines the *area of influence* of the well.

water users that suffer either of these types of well interference have the choice of installing better pumps, deepening their existing wells, or drilling new wells.[231]

Those who experience well interference may sue competing ground water users to enjoin them from pumping or to seek compensation for well improvement costs.[232] Well interference litigation is problematic because proving causation is usually very expensive and requires hydrological data and expert testimony. The highly scientific nature of the evidence also casts doubt on the outcome of the litigation. Ground water users tend not to litigate well interference claims because they involve such high costs and uncertain risks.[233] Negotiation and settlement is instead the preferred method for resolving well interference conflicts.[234] This is true in Alberta where there is no legal alternative but to shut down appropriators in reverse order of seniority if competing well owners do not voluntarily apportion well interference costs between themselves.[235] The hardship of a complete shut down is, understandably, a strong incentive to voluntarily apportion well interference costs.

Todd, *supra* note 7 at 115 [emphasis in original].

[231] See Percy, *Ground Water*, *supra* note 150 at 12.

[232] See *e.g. Prather* v. *Eisenmann*, 261 N.W.2d 766 at 771-772 (Neb. 1978) (ordering junior appropriator to pay compensation to senior appropriator for cost of deepening adversely affected wells so all parties can receive water in the future).

[233] See Corker, *supra* note 22 at 150 (noting that "[g]roundwater lawsuits invite settlement because they are too costly to litigate, and results of litigation are too uncertain to justify the expense.").

[234] See Corker, *supra* note 22 at 152.

[235] See Percy, *Ground Water*, *supra* note 150 at 13.

From a theoretical perspective, Alberta's complete reliance on the principle of priority in time may lead to undesirable results in the context of well interference problems.

> If the [priority in time] statute were applied literally to the problem of competing well owners, it would prevent B [a junior ground water licensee] from ever operating a well if its effect was to deprive A [a senior ground water licensee] "of the supply to which his licence entitles him". Such an interpretation would prevent aquifers from being fully exploited and create absurd consequences. If A, for example, had chosen to drill a shallow well or to install and inadequate pump, A would have grounds for complaining that any subsequent well interrupted the supply to which he or she was entitled. If A's complaint succeeded, the development of further wells on the same aquifer would be prevented.[236]

Alberta Environmental Protection has de-emphasized this flaw in the Act by insisting that junior licensees compensate senior users (both licensed and domestic) for interference with ground water supplies.[237] This Departmental policy shifts the entire cost of deepening wells and/or installing better pumps solely on junior appropriators. However, this policy is "not easily justified" by the Act because the principle of priority in time is the *only* method for determining the rights of conflicting ground water users under the *Water Resources Act*.[238] Additionally, this solution lets senior appropriators play "dog in the manger" by purposefully drilling inadequate wells in anticipation of compensation from junior appropriators.[239] It may also not be fair for a junior appropriator to compensate a senior appropriator for well interference costs if the junior appropriator only uses a fraction of the ground water withdrawn from an aquifer. To saddle only one junior appropriator with well interference costs does not recognize the fact that *all* overlying ground water users lower the water table in any given aquifer. M. Mitchell Morse has argued in this regard that it is more equitable for all ground water users to pay a proportionate share of well interference costs.[240] But this "proportional" approach also has some serious drawbacks. First, it would require accurate data on how much ground water is used by each appropriator and how ground water moves in the aquifer itself. Second, the cost of compiling and interpreting such data would be burdensome in comparison to allocating well interference costs to the most junior appropriator. Last, ground water users may be added or subtracted from the population overlying the aquifer. Such changes may continually alter everyone's proportionate share of pumping and well interference costs. Administrators would thus have to recalculate well interference costs on a regular basis to make sure that everyone pays their fair share.

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[236] Percy, *Ground Water*, *supra* note 150 at 12.

[237] Percy, *Ground Water*, *supra* note 150 at 12-13.

[238] Percy, *Ground Water*, *supra* note 150 at 13.

[239] See Corker, *supra* note 22 at 178-182.

Apportioning well interference costs is a thorny problem that presents difficult issues of fairness, uncertainty, and administration. Doctrinal solutions struggle on each of these accounts because, like the Alberta approach, they are not easily adapted to different well interference scenarios and do not, in general, consider whether appropriators have acted reasonably in gaining or maintaining access to ground water supplies.

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[240] M.M. Morse, "Well Pumping and a Declining Water Table—An Economic Analysis" (unpublished paper for Water Law, Stanford University, 1967), *excerpt in*, Meyers et al., *supra* note 68.

3. *Ground Water Mining*

Ground water mining occurs when aquifer withdrawals exceed net recharge.[241] Mining produces undesirable consequences because ground water is depleted faster than its optimal rate.[242] "Common effects of ground water mining include: declining ground water levels; increased pumping lifts and costs; and reduced aquifer discharge to streams or lakes, subirrigation, or wetlands."[243] Mining also makes the task of solving other ground water problems more urgent because mined aquifers have finite "life spans" during which time other problems must be brought under control.[244] Given these exigencies, water managers must try to prevent ground water mining in the first instance.

The four doctrines of Western ground water law do not prevent ground water mining.[245] As Professor Aiken states:

> The absolute ownership [*i.e.* rule of capture] and reasonable use doctrines permit ground water withdrawals to occur without regard to whether mining is occurring. . . . The correlative rights doctrine addresses ground water mining in theory by prorating the "safe yield" of an aquifer among ground water users. In practice, however, the correlative

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[241] Meyers et al., *supra* note 68 at 629.

[242] J.D. Aiken, "Ground Water Mining Law and Policy" (1982) 53 U. Colo. L. Rev. 505 at 507 [hereinafter Aiken].

[243] Aiken, *supra* note 242 at 509.

[244] Prolonged overdraft can also lead to long term economic and environmental effects. "Economic effects include increased pumping expenses as water tables decline. Environmental effects may include land subsidence, surface vegetation reduction, and, along the coast, saltwater intrusion into aquifers." G.S. Weber, "Twenty Years of Local Groundwater Export Legislation in California: Lessons from a Patchwork Quilt" (1994) 34 Nat. Res. J. 657 at 660.

[245] See *e.g.*, M.J. Kelly, "Management of Groundwater Through Mandatory Conservation" (1984) 61 Denver L.J. 1 at 3 [hereinafter Kelly].

rights doctrine in California is part of the legal basis for integrating the use of groundwater and imported surface water supplies, not a policy for restricting ground water use if mining occurs.

> Appropriation states vary in their approaches to ground water mining. In theory, conflicts between ground water appropriators are resolved by requiring the junior appropriator to stop withdrawals when they interfere with those of senior appropriators. Similarly, restricting new appropriations when they may interfere with existing ground water appropriators may protect existing ground water users. Neither approach, however, will necessarily prevent ground water mining.[246]

Not unlike prior appropriation states, Alberta's water legislation does not prevent ground water mining. The *Water Resources Act*'s principle of "first in time, first in right" will allow administrators to shut down junior ground water appropriators when they interfere with senior water rights.[247] However, such interference may occur before or *after* an aquifer goes into overdraft.[248] Well interference is merely a function of the depth of two or more competing wells relative to the level of the water table. In contrast, mining results when net aquifer withdrawals exceed net aquifer recharge.[249] Mining may thus occur independent of well interference, or *vice versa*.[250]

Alberta is not a position to prevent ground water mining because it only prohibits well interference, not ground water mining. This shortcoming is evidenced by the Department of Environment's *ad hoc* creation of the 1990 "Ground Water Allocation Policy for Oilfield Injection Purposes".[251] As indicated in chapter two, this policy regulates ground water use by oil companies and essentially reserves ground water for existing and future domestic users.[252] The policy provides that:

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[246] Aiken, *supra* note 242 at 513-514.

[247] *Water Resources Act*, R.S.A. 1980, c. W-5, as amended, s. 35(1) [hereinafter *Water Resources Act*].

[248] See Kelly, *supra* note 245 at 3-10. See also Aiken, *supra* note 240 at 513-514.

[249] See Meyers et al., *supra* note 68 at 629.

[250] See Kelly, *supra* note 245 at 3-10 (stating that "[t]he prevailing legal doctrines regulating groundwater use were developed primarily to resolve conflicts among individual users, not to prevent depletion of groundwater supplies").

> An applicant [for a ground water licence] who proposes to use potable ground water for oilfield injection purposes will be restricted to a maximum of one half of the *long term yield* of a given aquifer in the immediate vicinity of the water source well. This will be enforced by limiting drawdown, as measured 150 metres from the water source well, to 35% during the first year of operation and no more than 50% over the life of the project. In addition, the monitoring stations must be available for inspection by designated local officials and affected parties to ensure that the community has immediate and accurate information on the aquifer performance.[253]

This policy does not establish a framework or protocol for making future ground water allocation decisions in problem areas. It only addresses the problem of oilfield injection users. By using such narrow, *ad hoc* administrative policies to regulate ground water, the government may respond more slowly (and perhaps even unpredictably) than it would if a legal framework for site-specific management were already in place. Although ground water problems require site-specific solutions, predictable and responsive ground water regulation must be based on an underlying legal and institutional management framework.[254] Alberta's policy approach to ground water regulation is currently not

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[251] Oilfield Policy, *supra* note 38.

[252] See Chapter Two, *supra* notes 172-189.

[253] Oilfield Policy, *supra* note 38 [emphasis added].

[254] Professor Lucas concludes in this regard that:

> [W]ater planning functions [need] a firm legal basis. In particular, authority to

based on any such framework. The most that can be said is that the new *Water Act* contains a general provisions preventing the issuance of licences not in the public interest.[255]

However, Alberta's policy on oilfield injection has brought the province closer to site-specific management. It implicitly supports the position that ground water is best allocated in problem areas through a legal framework for site-specific management. The policy indicates that site-specific information is necessary to prevent ground water mining, for it premises its allocation decisions on site-specific criteria such as the "*long term yield*" of a given aquifer and collection of "*accurate information*" on aquifer performance.[256] Such data on net ground water withdrawal and recharge is essential for setting pumping limits that will prevent overdraft conditions.[257] Moreover, the policy also calls for inspection by "*local officials and affected parties*", indicating that it is beneficial to manage and enforce

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> prepare management plans should be spelled out in the water rights legislation. The legal effect of these plans, once prepared, should be made clear and should be related to the water licensing systems. This would mean that licences could validly be conditioned to ensure that water use would conform to the objectives of management plans. Current informal planning activities aimed at placing individual water licensing decisions within overall management objectives would then have the legal basis to support their long-term effectiveness.

Lucas, *Security, supra* note 174 at 99.

[255] *Water Act*, s. 34.

[256] Oilfield Policy, *supra* note 38 [emphasis added].

[257] See Aiken, *supra* note 242 at 516-517.

ground water allocation decisions in the local community.[258] So even though Alberta has not yet created a legal framework for site-specific management, its policy approach shows that site-specific information, enforcement, and management are essential to the protection of the resource. The unproclaimed *Water Act*'s provision for the creation of water management plans further evidences support for localized planning.[259] These considerations reinforce the position of this thesis—that the prevention of ground water mining is best achieved via a legal framework for site-specific ground water management.[260]

4. Non-conjunctive Management of Ground Water and Surface Water Resources

The final problem facing existing doctrines of ground water law involves nonconjunctive management of ground water and surface water resources. It is artificial to regulate ground water and surface water as different resources because ground water often migrates into the surface water phase of the hydrologic cycle, and *vice versa*.[261]

> Most commentators on groundwater management recognize that groundwater and surface water must be managed together because withdrawing groundwater may cause more surface water to percolate into aquifers, thereby depleting surface supplies. Blocking off or diverting surface supplies may cut back on infiltration and deplete groundwater supplies. In addition, halting or reducing groundwater withdrawal may reduce infiltration and percolation and thereby act to increase surface water supplies.

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[258] Oilfield Policy, *supra* note 38 [emphasis added].

[259] *Water Act*, ss. 7-14.

[260] See also Corker, *supra* note 22 at 178 (arguing that decisions on ground water mining should be "consciously made by those most closely affected").

[261] See generally R. Bowen, *Groundwater*, 2d ed. (Essex: Elsevier Applied Science Pub. Ltd., 1986) at 4 [hereinafter Bowen].

> - Failure to treat groundwater and surface as unified or interacting supplies has resulted in a denial of relief to plaintiffs in well-interference cases where surface water diversions caused wells to dry up and in cases where stream obstructions prevented groundwater drainage, resulting in flooded lands.[262]

Ground water and surface water are thus interconnected components of the hydrological cycle and should be regulated as such.[263]

Officials with Alberta Environmental Protection admit that conjunctive management has not been a priority in the province.[264] This problem stems from the fact that Alberta's ground water and surface water licensing decisions are made by different officials.[265] These officials rarely have the time and opportunity to collaborate together on licensing decisions.[266] This division of administrative duties has worked well in the past during times of minimal ground water use and adequate surface water supply. However, surface water and ground water use is increasing in the province, exposing the weakness in the present system.[267] Increased demand on water resources make conjunctive management plans a necessity. Without such plans, ground water and surface water users may cause unpredictable damage to the resource.[268]

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[262] Smith, "Coercion", *supra* note 205 at 805.

[263] Karvinen et al., *supra* note 1 at 3.

[264] de la Cruz, *supra* note 30.

[265] See de la Cruz, *supra* note 30.

[266] See de la Cruz, *supra* note 30 (noting that, in the vast majority of cases, ground water and surface water licensing decisions are made independent of one another).

[267] *Cf.* P.T. Babie, *The Implementation and Operation of a Transferable Water Rights System in Alberta* (LL.M. Thesis, University of Melbourne, 1995) at 128 [hereinafter Babie] (projecting increasing water scarcity and developmental pressure on water resources in Alberta).

The *Water Resources Act* does not require integrated management of ground water and surface water resources, let alone all the natural resources within a particular basin. As such, it is a doctrinal impediment to more effective ground water management. The *Water Act* differs radically in this regard, for it requires the Minister of Environment to develop a framework for water management planning.[269] Ground water management areas could be one part of such a provincial integrated resource management plan. The *Water Act* does not specify the institutional framework that will be used to implement site-specific ground water programs within designated water management areas. However, the *Water Act* clearly anticipates that local conditions and community input will shape the planning process and the remedial programs to be used in any given ground water management area.[270] Community input was a key element of the drafting process leading up to the *Water Act* and has been identified as an important component of water management planning.[271]

This chapter will now move on to discuss some of the remedial programs that Alberta could integrate into its future ground water management plans. Remedial programs provide physical solutions to the problems of waste, well interference, mining, and non-conjunctive management.

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[268] See Karvinen et al., *supra* note 1 at iii.

[269] *Water Act*, s. 7.

[270] Recall that the planning framework contemplated by the *Water Act* may include "opportunities for local and regional involvement". *Water Act*, s. 7(2)(d). The Minister may also develop a water management plan in co-operation with "any person" and "local authorities". *Water Act*, s. 9(2).

[271] WMRC Report, *supra* note 37.

B. Using Site-Specific, Remedial Programs to Solve Ground Water Problems

Ground water supply has traditionally outweighed demand in most of Canada.[272] By comparison, dry conditions and tremendous water demand in the Southwest have led several American states to enact site-specific management plans that address chronic ground water problems. More than thirty states now have legislation for establishing ground water management areas and management plans.[273] As serious water shortages may soon be a reality in parts of Alberta, lawmakers in this province should also consider using site-specific management plans to allocate scarce ground water resources.[274]

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[272] See Karvinen et al., *supra* note 1 at 4 (remarking that "[a]lthough no major water shortages have been reported in Canada, there are local problems").

[273] See J.A. Bowman, "Ground-Water-Management Areas in United States" (1990) 116 J. Water Res. Planning & Mgmt. 484 at 488 [hereinafter Bowman]. The thirty states with current or pending ground water management legislation are: Alaska; Arizona; Colorado; Connecticut; Delaware; Florida; Hawaii; Idaho; Illinois; Indiana; Iowa; Kansas; Louisiana; Mississippi; Montana; Nebraska; Nevada; New Jersey; New York; New Mexico; North Carolina; Ohio; Oregon; South Carolina; South Dakota; Texas; Utah; Virginia; Washington; and Wyoming. *Ibid.* Notably absent from this list is the state of California. Although it does not have comprehensive ground water legislation *per se*, special districts and legislatively created districts regulate ground water withdrawals in California's most water short and highly populated areas. See generally E.L. Garner, M. Ouellette & R.L. Sharff, Jr., "Institutional Reforms in California Groundwater Law" (1994) 25 Pacific L.J. 1021 at 1030-1035 [hereinafter Garner et al.].

[274] *Cf.* Corker, *supra* note 22 at 152. Professor Corker's seminal work on ground water management implicitly supports the site-specific management of scarce ground water resources in Alberta. As he states, ground water "problems invite *ad hoc* and localized solutions, negotiated settlements, and arrangements susceptible of alteration with changed conditions and increased knowledge about the water supply and opportunities for its utilization." *Ibid.*

Remedial programs are an essential part of site-specific ground water management plans. These programs bridge the gap between hydrogeology and law by providing physical and regulatory solutions to ground water problems. Several remedial programs may, depending upon the characteristics of a particular ground water basin, be useful for solving the problems of waste, well interference, ground water mining, and non-conjunctive management. Additionally, there is a whole score of ground water pollution control mechanisms, outside the scope of this thesis, which should be integrated into any "ideal" site-specific ground water management plan. Preventing and remediating groung water pollution makes more ground water available to users and thereby makes other ground water allocation problems less critical. The task is to choose from amongst the available quality-oriented and quantity-oriented ground water programs to choose those best suited to the management area and the varying demands on the resource.

1. Programs for Reducing Waste

The most effective way to reduce waste is to make water users pay for the resource in proportion to actual water use.[275] Water users tend to conserve water when they have to pay more for the resource.[276] Proportional user fees thus encourage people to conserve rather than waste water on nonproductive or marginally productive activities. Despite these advantages, proportional water user fees are not a politically viable idea in Alberta. User fees (or "water taxes" as they are known in the media) are a political liability in this province.[277] Alberta's strong agricultural lobby is adamantly opposed to taxing water use because it may adversely affect allegedly slim profit margins.[278] The political power of the agricultural lobby is reflected in a licensing exemption for "agricultural users" in the *Water Act*.[279] Given these political problems, it is no surprise that legislators are looking for other ways to curtail waste. Accordingly, legislators enacted the *Water Act*'s system of transferable water rights which encourages conservation, but does not "tax" existing users on their present water allocation.[280]

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[275] See A.M. Gregory, "Groundwater and Its Future: Competing Interests and Burgeoning Markets" (1992) 11 Stan. Env. L.J. 229 at 235. Gregory states that "[o]nly the internalization of all costs can encourage rational, cost-effective decision making." *Ibid.*

[276] An excellent example of this conservation incentive exists here in Alberta. The City of Edmonton charges municipal users a proportionate or "metered" water user fee. In contrast, the City of Calgary charges municipal users a flat rate for water. Without the economic incentive to conserve, Calgarians use roughly twice as much water as Edmontonians.

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[277] Alberta's former Minister of Environment, Brian Evans, withdrew a plan to impose water user fees after a strong political backlash. See Florence Loyie, "Province Floats Idea of Tax on Tap Water" *The Edmonton Journal* (17 August 1994) at A1 (summarizing unpopular water tax idea).

[278] See "Briefly: Tax All Wet" *The Province* [Vancouver] (17 August 1994) at A30 (quoting Brian Evans as stating: "We haven't had a great deal of enthusiasm from the average Albertan for the concept [of proportional water user fees].").

[279] *Water Act*, s. 19(1) (allowing unlicensed agricultural users to consume up to five acre feet of water per year for the purpose of raising farm animals or applying pesticides to crops). Agricultural users may combine their unlicensed water entitlement with an unlicensed privilege to use one acre foot of water per year for domestic or household purposes. *Water Act*, s. 21(1). See also Percy, "Seventy-Five Years" *supra* note 183.

[280] See *Water Act*, s. 81(7) which provides:

> (7) An application for a transfer of an allocation of water under a licence may be made only if
>
> (a) the ability to transfer an allocation in the area of the Province referred to in the application has been authorized
>
> (i) in an applicable approved water management plan, or
>
> (ii) if there is not applicable approved water management plan, by and order of the Lieutenant Governor in Council, ...

Ibid.

Commentators suggest that transferable water rights reduce waste by creating monetary incentives to sell water to more productive uses.[281] Transferable rights create "water markets" in which users may sell all or part of their water allocation for profit, rather than wasting water on less lucrative and less productive activities.[282] A system of transferable rights brings together the best of both worlds: it creates an economic incentive to conserve water without "taxing" all existing water users for their present water use. The proposed Alberta *Water Act* includes provisions for transferring water licences for these very reasons.[283] But transferable water rights and market incentives do not work in all situations. As one author has stated:

> A commonly proposed solution to the waste problem is to abrogate legal restrictions on the transfer of water rights. This solution, however, rests on the assumption that water markets can provide proper monetary incentives for conservation. While the movement towards the market is a step in the right direction, the market alone is not enough.[284]

Water users will probably continue to waste water if the market fails because of externalities or high transaction costs.[285] "Market lag" may also be a problem, especially where users already place considerable demand on overdrawn and overallocated water supplies.[286] To guard against these failures, some jurisdictions supplement their system of transferable water rights with site-specific remedial programs that are designed to prevent waste.[287] Such remedial programs guard against the risk of market failure and impose direct controls on waste.[288] Remedial waste programs are also flexible, targeting critical areas for increased regulation without overregulating water-abundant regions.

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[281] H.I. Rueggeberg & A.R. Thompson, *Water Law and Policy Issues in Canada* (Vancouver: Westwater Research Centre, 1984) at 8 [hereinafter Rueggeberg et al.].

[282] See *e.g.* B. C. Saliba & D. B. Bush, *Water Markets in Theory and Practice*, (1987), *excerpt in*, Sax et. al, *supra* note 47 at 216. For an excellent discussion of market theory and water resource allocation see C.J. Meyers & R.A. Posner, *Market Transfers of Water Rights: Toward an Improved Market in Water Resources*, National Water Commission Study No. 4 (Arlington, Va.: U.S. Dept. of Commerce, 1971).

[283] See WMRC Report, *supra* note 37 at 48 (stating that "transfers may achieve many of the outcomes identified by the WMRC, including the outcomes of efficient and sustainable water use . . .").

[284] Pulver, *supra* note 208 at 674.

[285] See Bergin, *Virginia Water Law: An Economic Appraisal* (1975), *excerpt in*, Percy, *Seminar Materials*, *supra* note 209 at 75-77.

To implement waste reduction programs water managers must first learn about the ground water use and abstraction within the affected ground water area.[289] Well metering programs and water reporting programs are two of the remedial programs essential to this end.[290] These programs give water managers accurate data on how people are extracting and using ground water. Metering is a fairly straightforward process requiring the installation of well head water measuring devices.[291] Similarly, water use reporting requires users to meter ground water withdrawals and return flow, and account for how their water is put to use.[292] Metering and recording are critical for addressing the problem of waste because these measures provide water managers with general information on water use within the management area. Much of the necessary metering and recording information is already available in Alberta, where yearly water use is measured and government inspections and investigations are a possibility.[293] Water managers will be able to use recorded data to initiate investigations into wasteful use under the new Act.[294] Should such investigations reveal that a user is wasting water, an official in the ground water management area (if the management entity is locally controlled) or the Director of Water Resources (if the management entity is provincially controlled) will have the discretion to amend or cancel the offending user's water licence.[295] Officials may amend licences by reducing the user's allocation by the amount of waste. Cancellation is an extreme measure best reserved for cases of extreme and/or malicious waste.

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[286] *Cf.* J.L. Harrison, *Law and Economics in a Nutshell* (St. Paul, Minn.: West, 1995) at 65 (noting that bargaining creates a kind of "friction" which delays market transfers). Note that under the *Water Act* Alberta may also experience a "pre-market lag": Section 81(7) requires an approved water management plan or a Cabinet order *prior* to any transfer of water.

[287] See generally Kelly, *supra* note 245 at 11-14 (arguing that to improve water conservation, jurisdictions should impose need-based pumping limits similar to those contained in the Arizona *Groundwater Management Act*).

[288] See Rueggeberg et al., *supra* note 281 at 9 (stating that the "ideal" water allocation system should include market incentives to conserve and "provisions that compel efficient water use"). Sections 8 and 15 of Alberta's *Water Act* will prevent some of the adverse consequences of market failure because they require the Minister of the Environment to develop a strategy for the protection of the aquatic environment including the development of guidelines for establishing water conservation objectives.

[289] See Bowen, *supra* note 261 at 338 (explaining the four stages of data collection and investigation necessary for managing ground water basins: preliminary survey; reconnaissance; feasibility; and project).

[290] See S.E. White & D.E. Kromm, "Local Groundwater Management Effectiveness in the Colorado and Kansas Ogallala Region" (1995) 35 Nat. Res. J. 275 at 284 [hereinafter White & Kromm].

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[291] See generally R. Kent, D. McMurtry & M. Bentley, "Groundwater Monitoring, Control, and Analysis", *in*, E. T. Smerdon & W. R. Jordan, eds., *Issues in Groundwater Management* (Austin: Center for Research in Water Resources, 1985) [hereinafter Smerdon et al.].

[292] See G.A. Gould, "Recent Developments in the Transfer of Water Rights", *in*, K.M. Carr & J.D. Crammond, eds., *Water Law: Trends, Policies, and Practice* (Chicago: ABA Section of Natural Resources, Energy, and Environmental Law, 1995) at 94 (noting the desirability of replacing return flows to streams and alluvial aquifers).

[293] See *e.g.* *Water Resources Act*, ss. 42-45 (complaints and inspections).

[294] See *Water Act*, s. 128(1) (empowering investigators to "enter any place or gain access to any place for the purpose of responding to a complain or conducting an investigation"). Of course, if administrators conduct investigations using a traditional, lax standard for measuring waste (as discussed *supra*), limited benefits may flow from this provision.

[295] See *Water Resources Act*, s. 51(1) (allowing Minister to amend or cancel licences for wasteful water use). See also *Water Act*, s. 97(2) (allowing Director to "issue any person a water management order for conservation purposes").

Water managers should also develop and administer proactive waste reduction programs in addition to collecting data and conducting investigations. Public education programs are useful for this purpose because they help reduce waste by informing users of more efficient water practices.[296] Programs that educate urban and rural users on the conservation effect of watering lawns at night, using flow-restricting shower heads, and installing smaller toilet tanks all help conserve water.[297] Education programs for irrigators would impart the water saving advantages of proper well construction, level crop fields, and drip irrigation technology.[298] Industrial users, such as car washes and water-intensive manufacturing companies, would benefit from information on water recycling technologies.[299] Hence, it is possible to reduce waste on a site-specific basis with a variety of remedial programs including: amending or cancelling licences in extreme situations; implementing data collection, education, and monitoring programs; and promoting water-conservation in the community.[300] Giving ground water users tax credits for conserving ground water by reducing consumption, or by installing more efficient pumps and works, may also effectively reduce waste. This is another financial incentive, like transferable water rights, that may help conserve the resource.

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[296] See *e.g.*, Alberta Environment, "Water Management in Alberta: Challenges for the Future" Background Paper Vol. 6 at 3, 6 (urging "users to be more careful in their usage of water" and calling for education programs about "water conserving technologies, methods to reduce waste, and water efficient behavior").

[297] According to one estimate, using more efficient toilets, shower heads, washing machines, and faucets could reduce municipal water use by up to 22%. See R. Jensen, "Indoor Water Conservation" (Winter 1991) Tex. Water Resources at 4.

[298] See Pring & Tomb, *supra* note 226 at 25-7. Commentators observe that there are several conservation strategies for improved irrigation efficiency:

> Measures for improving off-farm conveyance efficiency include: (1) piping or lining of canals and laterals to reduce seepage, (2) flow-measuring devices, regulating devices (such as checks, drops, flumes), and automated facilities, and (3) water delivery scheduling. On-farm improvements include: (1) ditch lining or piping, (2) land leveling (for better control and more uniform water application), (3) water control structures (checks, drops, divider boxes), (4) automated irrigation systems, (5) flow measuring devices, (6) tailwater recovery systems, (7) irrigation methods (surface, sprinkler, drip), and (8) on-farm irrigation water management (rate, amount, timing controls).

Ibid.

2. *Programs for Preventing Well Interference and Apportioning Well Interference Costs*

Water managers should make every effort to prevent well interference before it becomes a problem. A number of proactive programs help achieve this goal including educational programs that reduce waste and encourage water conservation.[301] Data collection and metering programs are also important because they give decision-makers information on the amount and location of ground water use.[302] This information is the foundation for three more-specific well interference programs: well spacing; well construction and pump standards; and pumping schedules.

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[299] Alberta Environment currently requires industrial, *in situ* oil recovery water users in the Cold Lake-Beaver River Water Management Area to recycle water. See Alberta Environment, "Water Management in Alberta: Challenges for the Future" Background Paper Vol. 6 at 3.

[300] Although these activities would have a desirable effect in reducing waste, they may not be obvious responses to the imposition of a waste prohibition. Water managers would have to take a leadership role in instituting these activities in addition to simply prohibiting waste.

[301] See *supra* note 288 and accompanying text.

[302] See *supra* note 289 and accompanying text.

First, well spacing ensures that wells are not located so near to one another that one party's well bottom is located inside another well's cone of depression. Spacing also helps regulate the amount of water one drains away from another's well, even where overlapping cones of depression are not at issue. Optimal spacing patterns vary depending upon hydrogeology and the depth and capacity of ground water wells. Pre-drilling investigations provide management authorities with the information necessary to develop general well spacing criteria and make well spacing decisions. Because domestic ground water users are not required to obtain water licences, numerous wells in the province may not be properly spaced for efficient production.

Second, well construction standards, well depth standards, and pump setting standards help prevent well interference.[303] These standards and settings all affect the size of a well's cone of depression and the amount of ground water withdrawn from an aquifer.[304] Water managers are able to prevent well interference by regulating these variables. For example, water managers can prevent landowners from locating deep, high-capacity wells near shallow, low-capacity wells. Regulating the location of wells by giving consideration to such factors reduces the likelihood of well interference. Once again, the number of originally unlicensed domestic ground water wells in Alberta raise the likelihood that inappropriate pumps and well construction may cause overlapping cones of depression between wells.

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[303] See M. Price, *Introducing Groundwater*, (London: George Allen & Unwin, 1985) at 109-112, 116-117 (describing pumps and maximum efficiency well designs).

[304] See Bowman, *supra* note 273 at 493 (noting that the most common ground water management programs include well spacing and "well construction and depth and pump setting standards").

Third, water managers may control well interference problems by rotating well pumping entitlements and coordinating pumping schedules.[305] Pumping schedules stagger ground water withdrawals to avoid well interference from wells located to near to one another. Pumping schedules may also curtail withdrawals during periods of low recharge. These programs are useful for optimizing withdrawals from areas of variable ground water levels and poor well spacing as they prevent users from extracting scarce ground water resources at the same time.

Although proper planning will greatly reduce ground water problems it will not prevent them altogether. Well interference conflicts are bound to arise because of inadequate hydrogeologic data, the poor condition of some old wells and pumps, and increasing water use. Clear legal rules must be in place before well interference conflicts arise. Such rules encourage cooperation because they allow users to consider the potential consequences of litigation. This in turn encourages competing ground water users to voluntarily apportion well interference costs.[306]

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[305] See Bowman, *supra* note 273 at 493.

Alberta currently has clear rules for apportioning well interference costs.[307] However, as noted in subsection A2 above, these rules may also lead to absurd and harsh consequences.[308] A case in point is the legal requirement of shutting down junior users whenever well interference is a problem.[309] A preferable approach is to make junior users compensate senior users for well improvement costs.[310] Senior users should receive such compensation when their wells are of a "reasonable" depth and construction, and the their pumps are of a "reasonable" capacity.[311] In other words, the law should protect a senior user's clearly reasonable means of access to ground water. This approach fosters security of title and encourages efficient development because it protects existing users without letting unreasonable users limit the development of the resource. In resolving well interference conflicts, courts and regulators should have the authority to order physical solutions to the problem, as well as costs.[312] These physical solutions may include deepening or relocating one or more wells, acquiring additional supplies of water, and/or supplying junior and senior users from the same well.[313] As Professor Corker concludes in this regard, water authorities and courts should consider six general propositions when creating or interpreting the rules for well interference conflicts:

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[306] Alternative dispute resolution may be an effective technique for reaching voluntary agreements on well interference costs. See generally E.J. Swanson, "Alternative Dispute Resolution and Environmental Conflict: The Case for Law Reform" (1995) 34 Alta. L. Rev. 267. See also E.Ostrom, *Governing the Commons: The Evolution of Institutions for Collective Action*, (Cambridge: Cambridge Univ. Press, 1990) at 90 (finding that long-enduring common pool resource institutions generally give "[a]ppropriators and their officials . . . rapid access to low-cost local arenas to resolve conflicts among appropriators or between appropriators and officials.") [hereinafter Ostrom].

[307] See *supra* note 45 and accompanying text.

[308] See *supra* note 46 and accompanying text.

[309] *Ibid.*

[310] See generally E.D. Lotterman & J.J. Waelti, "Efficiency and Equity Implications of Alternative Well Interference Policies in Semi-Arid Regions" (1983) 23 Nat. Res. J. 323 at 325-334.

[311] See Corker, *supra* note 22 at 181. By local negotiation and administrative policy, ground water users in Alberta pay for well improvement costs. However, this practice is not guided by a "reasonable depth" or "reasonable capacity" criterion.

> (a) A reasonable means of access should not be impaired or destroyed without compensation.
>
> (b) The criteria used in determining what is reasonable should be liberal. These criteria should take into account the general character of the uses in a basin and the date when an affected use was instituted, if within the most recent, say, 10 years.
>
> (c) Costs of physical modification should be awarded to [a senior appropriator] when his means of access is clearly reasonable. When this is unclear, costs should be allocated between the parties on the basis of fairness.
>
> (d) Relief should not be granted where the amount of damages is less than the cost of administering the award.
>
> (e) A physical solution should be adopted wherever feasible.
>
> (f) Jurisdiction [by the deciding court] should always be retained for modification in light of facts which may later arise.[314]

A rule of reasonable access is both fair and sensible. The reasonable access rule is fair because senior users should not be able to effectively shut down junior users in all cases of well interference.[315] It is sensible because it would not prevent future development of an aquifer simply because a senior user is encountering well interference.[316] While a reasonable access rule is not perfect, it is as clear and fair as practical given the near infinite number of variables affecting well interference conflicts.

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[312] See Corker, *supra* note 22 at 181-182.

[313] Corker, *supra* note 22 at 181.

[314] Corker, *supra* note 22 at 183.

[315] *Cf.* Percy, *Ground Water*, *supra* note 150 at 12.

3. Programs for Controlling Ground Water Mining

The need to control ground water mining makes a strong case for site-specific ground water management.[317] When an aquifer is "mined" other ground water problems become more serious.[318] Well interference increases when an aquifer goes into overdraft and the problems of waste and nonconjunctive management become more urgent. Regulators must, therefore, stabilize or increase ground water levels in overdrawn or nearly overdrawn aquifers as soon as possible. Such quick and effective regulatory responses require physical solutions that are tailored to the ground water area.[319] Site-specific remedial programs that are useful for this purpose include: data collection programs; public education programs; water metering programs; water conservation plans; alternative water source development programs; artificial recharge programs; weather modification programs; water recycling programs; and wastewater control programs.[320]

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[316] *Cf.* Percy, *Ground Water*, *supra* note 150 at 12.

[317] See *e.g.*, Petersen, *supra* note 23 at 1420 (asking state legislators to enact critical area legislation and impose direct regulations on ground water mining).

[318] *Ibid.*

[319] See Aiken, *supra* note 242 at 514.

[320] See Bowman, *supra* note 273 at 493 (noting that several states use these management programs in ground water management areas).

Each of the above programs may prevent, reduce, or optimize ground water withdrawals depending on the needs and hydrogeology of an area. However, before water managers can select the most effective combination of remedial programs they must answer the following question: How much ground water should be withdrawn from a ground water aquifer or interconnected flow system on an annual basis?[321] Water managers sometimes answer this question by requiring net ground water withdrawals to be less than or equal to the "sustainable annual yield" of an aquifer. Arizona's comprehensive *Groundwater Management Act*[322] takes such an approach. It seeks to achieve equilibrium between ground water withdrawals and recharge for aquifers located in "active management areas".[323] This approach is appropriate because Arizona's ground water is contained mostly in recharging aquifers, sixty-nine percent of which are in overdraft.[324] As discussed earlier,[325] the Alberta "Ground Water Allocation Policy for Oilfield Injection Purposes" also sought to preserve the long term yield of certain aquifers. Water managers in Alberta are, therefore, obviously aware that sustainable annual yield is a useful criterion for implementing water management programs. The new *Water Act* just provides a more explicit planning mandate for doing so.

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[321] See Aiken, *supra* note 242 at 513 ("The major policy issue related to ground water mining is whether the inevitable consequences of mining should be postponed by regulation.").

[322] Ariz. Rev. Stat. Ann. ss. 45-401 to 45-704 (West 1994).

[323] See R.J. Glennon, "'Because That's Where the Water Is': Retiring Current Water Uses to Achieve the Safe-Yield Objective of the Arizona Groundwater Management Act" (1991) 33 Ariz. L. Rev. 89 at 93 (summarizing the Arizona "safe-yield" goal).

[324] J.L. Kyl, "The 1980 Arizona Groundwater Management Act: From Inception to Current Constitutional Challenge" (1982) 53 U. Colo. L. Rev. 471 at 482 [hereinafter Kyl]. Despite the urgency of the problem in Arizona, the goal of "safe yield" is being gradually introduced to avoid immediate water shortages. *Ibid* (noting that Arizona seeks to achieve safe-yield by the year 2025).

[325] See Chapter Two of this thesis, *supra* at part F.1.b.i.

The policy of sustainable annual yield can be varied in two situations. First, it is advantageous to withdraw more than the sustainable annual yield of an aquifer during drought conditions. The economic and social harm that result from lost crops, reduced industrial output, and municipal water shortages may make it advantageous for ground water withdrawals to exceed sustainable annual yield in such circumstances.[326] The optimal amount of overpumping or "mining" will depend on the amount of water available in the aquifer, whether the aquifer will be physically damaged by overpumping, the future value of the resource, and the present value of ground water activities.[327]

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[326] *Cf.* Aiken, *supra* note 242 at 527. It comes down to a cost-benefit analysis when deciding whether to overpump or to maintain safe-annual yield. This is also true of the entire problem of ground water management. *Ibid.*

[327] See Corker, *supra* note 22 at 174. In making such decisions, water managers must realize that there is no linear relationship between overpumping and declining aquifer levels. When excessive amounts of ground water are withdrawn from an aquifer the water table may reach such a low level that the aquifer will no longer recharge with precipitation. This occurs because surface vegetation will use up all the available precipitation when aquifer levels are low. A reduction in the rate of recharge will also occur when the dry pores of an aquifer's upper region create "soil-water suction". See M. Price, *Introducing Groundwater*, (London: George Allen & Unwin, 1985) at 31. Water managers must be careful, therefore, not to calculate the life span of a recharging aquifer by simply dividing the aquifer's total volume of water by the total amount of annual withdrawal. Using simple calculations like this will result in an overestimation of the life span of an aquifer. Instead, aquifer levels must be constantly monitored to avoid letting water levels get so low as to diminish recharge. The complicated analysis that goes into interpreting water levels and calculating overpumping show why it is important to manage ground water on a site-specific basis, rather than according to preset rules. Personal Communication from Dr. J. Toth, Faculty of Science, Earth and Atmospheric Studies, University of Alberta, to the author (April 1996) (explaining nonlinear relationship between aquifer levels and ground water pumping) [hereinafter Toth].

Second, overpumping will be a reality when an aquifer has little or no recharge.[328] The policy question relevant to such "nonrecharging" aquifers is: What is the optimal rate of depletion? The process of calculating overpumping limits for recharging aquifers is the same as calculating the optimal depletion period for nonrecharging aquifers: regulators consider the amount of water available, the potential of damage to the resource, the future value of the resource, and the present value of ground water activities. As such, optimal depletion periods vary because different communities discount the future benefits of ground water at higher or lower levels.[329] The laws of two states illustrate this point. New Mexico sets the optimal depletion period for its nonrecharging aquifers at forty years.[330] This period is based on the fact that nearly eighty percent (80%) of the ground water consumed in New Mexico is used by irrigators, and that it generally takes two generations—or forty years—to pay off irrigated farms.[331] In comparison, Colorado sets the optimal depletion period for its nonrecharging aquifers at twenty-five years.[332] Twenty-five years "was chosen to protect bankers, not farmers,"[333] as this time span is equal to the average period for repaying loans to finance ground water wells and pumps. The Colorado and New Mexico time periods show that doctrinal rules that define optimal depletion periods ignore the variable hydrogeology of aquifers and the different social and economic needs of ground water users. Optimal depletion periods should instead be calculated for each nonrecharging aquifer. In essence, an optimal depletion period should equal the amount of time it takes to come up with an alternate water source. If no alternative water source is available or is socially, economically or environmentally advisable, then the optimal depletion period should equal the amount of time it takes to eliminate ground-water-dependent activities and replace them (if possible) with less consumptive activities that will not exceed sustainable water resources. In some situations, this might include retiring certain types of land use activities, such as agriculture, aquaculture, etcetera. Jurisdictions should only revert to blanket or doctrinal allocation rules if site-specific analysis costs more than the economic value of the ground water it conserves.[334]

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[328] See Corker, *supra* note 22 at 175-178.

[329] Ostrom, *supra* note 306 at 34.

[330] *Mather* v. *Texaco*, 421 P.2d 771 at 777 (N.M. 1966).

[331] Trelease, *supra* note 21 at 870.

[332] *Fundingsland* v. *Colorado Ground Water Comm'n*, 468 P.2d 835 at 837 (Colo. 1970).

[333] Trelease, *supra* note 21 at 870.

As for selecting remedial ground water programs, it is noteworthy that those programs that reduce water consumption also help control the adverse effects of ground water mining. This is equally true for recharging and nonrecharging aquifers because data collection programs, public education programs, water metering programs, and water conservation plans all contribute to increased ground water levels.[335] These programs increase water levels by encouraging conservation and limiting ground water withdrawals. For example, mandatory water conservation plans increase water levels by setting individual or group pumping limits.[336] Depending on the jurisdiction and the powers of the ground water management body, pumping limits may apply pro rata to all users or only to the most junior users.

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[334] As Aiken notes: "The important issue relative to ground water controls is whether the cost of administering regulations and any economic benefits postponed due to ground water controls are outweighed by the future economic benefits achieved by extending aquifer life." Aiken, *supra* note 242 at 527.

[335] See Bowman, *supra* note 273 at 492-493.

Several other programs also increase ground water levels, but in a different way than conservation-type programs. Instead of reducing withdrawals, these other programs increase water availability and recharge. Major water projects have historically been used to increase water supply.[337] Projects such as dams, canals, and pipelines require the construction of works to bring water to a water-short region. Unfortunately, water development programs usually involve high economic and environmental costs.[338] The Oldman River Dam in southern Alberta is a good example of this problem, for it is unlikely that the irrigators it serves will be able to offset the capital costs of the project with increased productivity.[339] Commentators also criticize major water projects for perpetuating wasteful and inefficient water practices.[340] Users tend not to conserve water once they have a new, adequate supply of water.[341] Given these two forceful criticisms, major alternative water resource development projects are rarely the best option for increasing water supply and reducing ground water mining.

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[336] See Kelly, *supra* note 245 at 2 (arguing for need-based quotas).

[337] The trend towards water development in the West is aptly described by Dean Trelease's comment: "if you have a water problem, pour water on it and it will go away." Trelease, *supra* note 21 at 865.

[338] The "vicious circle of overdraft-rescue" is one consequence of boosting water supplies with major, federally funded water projects. *Cf.* Trelease, *supra* note 21 at 873 (noting that California got into the "vicious circle of overdraft-rescue quite accidently, as an unforeseen result of the adoption of correlative rights").

[339] In total, Albertans have spent over $1 billion on dam and waterworks projects to try and alleviate Alberta's water shortages. D. Holehouse, "Water Crisis Severe Test for Alberta" *The Edmonton Journal* (26 Nov. 1988) at C1. Analysts conclude that major dam projects like the Oldman River Dam

Water managers must consider using less expensive water supply programs because of the high cost of major water projects. Weather modification, artificial recharge, water recycling, and wastewater control programs are helpful in this regard.[342] Weather modification programs decrease ground water demand by stimulating natural

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are not economically efficient propositions. See T.S. Veeman, *Water and Economic Growth in Western Canada*, Discussion Paper No. 279 (Ottawa: Economic Council of Canada, 1985) at 28 (stating that "it has been historically difficult to justify irrigation projects on the prairies in terms of economic efficiency").

[340] See J.E. McKinnon, "Water to Waste: Irrational Decisionmaking in the American West" (1986) 10 Harv. Env. L. Rev. 503 at 503. As Ms. McKinnon states, the once small farms that needed water supply augmentation at the turn of the century are now

> large modern agribusinesses representing a significant part of the West's economy. The dams build to store irrigation water are engineering marvels. Inexpensive, fresh produce is available year-round across the country. Thanks to irrigation, the desert does indeed bloom. However, under its present administration, the irrigation program produces an array of problems that demand immediate rectification. The price that farmers are charged for the irrigation water is unreasonably low, causing adverse economic and environmental consequences.

Ibid.

[341] See "Critics Urge Alternatives in Water Management" *The Edmonton Journal* (26 Nov. 1988) at C1 (noting that there is support for dam projects in Calgary, but not water conservation).

[342] See generally White & Kromm, *supra* note 290 at 284-287.

precipitation.[343] As White and Kromm note, these programs "attempt to enhance precipitation and suppress hail by using aircraft to seed clouds."[344] The rain induced by cloud seeding reduces ground water withdrawals by adding water to surface reservoirs and naturally irrigating crops. Precipitation also seeps back into aquifers, recharging the ground water supply.

Water recycling, artificial recharge, and wastewater control programs also reduce ground water withdrawals by encouraging the reuse of water.[345] Water recycling involves the capture, treatment, and reuse of wastewater. Wastewater control programs route wastewater to treatment facilities, where it can be later redistributed for various purposes. Recycled water may be used for things like watering golf courses, supplying industry, and irrigating crops. Additionally, municipalities and irrigators sometimes reintroduce recycled water into aquifers to increase ground water levels.[346] This method of reintroduction is just one type of "artificial recharge" that increases ground water supplies.

> In order to increase the natural supply of groundwater, people artificially recharge groundwater basins. Artificial recharge may be defined as augmenting the natural movement of surface water into underground formations by some method of construction, by spreading of water, or by artificially changing natural conditions. A

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[343] See "Critics Urge Alternatives in Water Management" *The Edmonton Journal* (26 Nov. 1988) at C1 (observing that Israel increased its rainfalls by 15% with a cloud seeding program similar to the one developed by the Alberta Research Council).

[344] White & Kromm, *supra* note 290 at 284.

[345] See generally Todd, *supra* note 7 at 458-488.

[346] See Todd, *supra* note 7 at 475.

> variety of methods have been developed, including water spreading, recharging through pits and wells, and pumping to induce recharge from surface water bodies. The choice of a particular method is governed by local topographic, geologic, and soil conditions, the quantity of water to be recharged, and the ultimate water use. In special circumstances land value, water quality, or even climate may be an important factor.[347]

Artificial recharge has another benefit as well: underground storage prevents scarce water from evaporating as it does in surface canals and reservoirs.[348] In the final analysis, water recycling, artificial recharge and related programs are attractive options for increasing ground water supplies and preventing ground water mining without the high costs of major water development projects.

4. Programs for Promoting Conjunctive Management

Conjunctive management of water resources is probably the most difficult task facing water managers today. As Professor Clark notes, "[t]he regulation of groundwater use . . . most probably reaches the highest point of sophistication where, consistent with the unity of the hydrological cycle, it achieves the planned conjunctive and complementary use of surface-water and groundwater."[349] Data collection and unified surface and ground water allocation decision-making are the key programs for promoting conjunctive management.[350] These programs require extensive hydrogeological data on the nature and movement of all water resources within a basin-management area. Additionally, conjunctive management requires physical facilities for water distribution, for artificial recharge, and for pumping. "Such operations can be complex and highly technical; they require competent personnel, detailed knowledge of the hydrogeology of the basin, records of pumping and recharge rates, and continually updated information on groundwater levels and quality."[351]

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[347] Todd, *supra* note 7 at 458.

[348] See generally Bowen, *supra* note 261 at 227-224. Artificial recharge may also be useful for storing hot water in "hot storage wells" for use during the winter months. *Ibid.*

[349] S.D. Clark, *Groundwater Law and Administration in Australia*, Australian Water Resources Council, Technical Paper No. 44, (Canberra: Australian Gov't Press, 1979) at 164 [hereinafter Clark].

[350] See R.J. Glennon & T. Maddock, III, "In Search of Subflow: Arizona's Futile Effort to Separate Groundwater from Surface Water" (1994) 36 Ariz. L. Rev. 567 at 585. Glennon and Maddock state:

Conjunctive management involves coordinating water licensing decisions so that water managers "consider, not merely whether sufficient groundwater is available, but the quantity of water from other sources which is available to the applicant, and the effect of granting the application on the supply of other water users, whether they are supplies from surface or groundwater."[352] Conjunctive management also requires input from a full range of professionals to design future water storage and distribution systems for optimal efficiency. A typical conjunctive water resource plan would implement strategies for capturing and transferring of water to and from ground water aquifers. As Professor Todd states:

> Estimates of capture are fundamental to quantitative groundwater and surface water analyses and planning for any long term water supply. Two crucial hydrologic questions pertain to the problem: 1) what quantity of water already is being captured as a result of existing development? and 2) what potential for capture exists with new development?

Ibid.

[351] Todd, *supra* note 7 at 372.

[352] Clark, *supra* note 349 at 164.

> The concept of conjunctive use of surface water and groundwater is predicated on surface reservoirs impounding streamflow, which is then transferred at an optimum rate to groundwater storage. Surface storage in reservoirs behind dams supplies most annual water requirements, while the groundwater storage can be retained primarily for cyclic storage to cover years of subnormal precipitation. Thus, groundwater levels would fluctuate, being lowered during a cycle of dry years and being raised during an ensuing wet period.[353]

Although such a scheme of conjunctive management will not work in areas with limited ground or surface storage, it is viable in many instances. Less sophisticated schemes may also promote water conjunctive management. Water managers should thus always consider conjunctive management options before making allocation, water service, and water storage decisions.[354]

C. Conclusion

This chapter has shown that doctrinal approaches to ground water management, including Alberta's system of prior allocation, do not adequately control at least four major ground water problems. These ground water problems—waste, well interference, mining, and nonconjunctive management—threaten the sustainability of scarce ground water resources. Site-specific ground water management plans offer flexible, physical solutions to the problems. They do so with remedial ground water programs that provide physical solutions to ground water problems. The task for legal decision-makers is to place these remedial programs or physical solutions in a legal and institutional framework of ground water management. The next chapter of this thesis addresses this task by identifying those management institutions that are most effective at creating, assessing, and implementing ground water management plans and their attendant remedial programs. The final chapter then proposes how Alberta can integrate ground water management plans, remedial programs, and ground water management institutions into its legal system.

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[353] Todd, *supra* note 7 at 371.

[354] The American Water Works Association has devised a systematic approach for studying conjunctive use problems which includes: (a) identifying the nature of the problem; (b) identifying the level of the problem; (c) identifying all physical, economic, and legal variables; (c) determining the significant elements of the water system; (d) defining the social and other objectives of the water system; (e) engaging in system dynamics and mathematical modelling; (f) verifying the model; and (g) implementing the model to achieve optimal use and policy goals. See Todd, *supra* note 7 at 373 fig. 9.7.

CHAPTER FOUR

Management institutions, also known as management "entities", "bodies", or "authorities", are responsible for implementing remedial ground water programs and making ground water allocation decisions. This chapter analyses different types of ground water management entities. It first demonstrates that the process of selecting a management entity is only one part of a larger ground water planning process. This chapter then explains why "aquifer designation" must precede the management entity selection process. Only after designating a ground water management area may water administrators effectively select a ground water management entity using standards and guidelines set out in the jurisdiction's water legislation.

Water short jurisdictions have, over the years, used a variety of local, regional, and centrally-administered entities to implement remedial ground water programs. Based on the success of different types of management entities, this chapter suggests that a "multi-entity" ground water management framework is best suited to Alberta's varied hydrogeology and diverse group of ground water users.

A. Management Entities in Context: An Overview of the Ground Water Management Planning Process

The legal and institutional aspects of ground water management form a small but important part of the ground water planning process. Professor Todd observes that government agencies often undertake a four-level ground water planning process, of which few elements are legal in nature.[355] Todd identifies level I as a "preliminary investigation" phase that "identifies the management possibilities of meeting a defined need for a specified area." Level II involves ground water "reconnaissance", which usually requires hydrogeological investigation, data collection, and analysis of existing data. Level III is a "feasibility" study comprised of detailed engineering, hydrogeologic, and economic analyses, and cost and benefit estimates that ensure "optimum development" in the community. Level IV proposes a definite, comprehensive ground water management strategy, including final engineering designs and preparation of management plans.

Each level of the planning process has its own list of planning considerations. Only levels III and IV include institutional and legal considerations. For example, the American Society of Civil Engineers identifies a sequence of seventeen activities appropriate to a Level III feasibility investigation. Only *two* of these seventeen activities directly involves legal and institutional analysis. These activities are: (1) identify ground water problems; (2) select management objectives; (3) define elements of the management plan; (4) obtain authorization and financing for ground water investigation; (5) develop goals for investigation; (6) select scope of investigation; (7) develop work program for investigation; (8) create planning organization; (9) commence investigation; (10) project future water demands; (11) conduct surface and subsurface exploration; (12) assess water resources; (13) evaluate capability of extraction and recharge facilities; (14) determine aquifer boundary conditions (*i.e.* aquifer designation); (15) *consider legal and organizational factors, including type of management entity required*; (16) *formulate plans for water resource management, including remedial ground water programs*; and (17) prepare a report on the entire investigation.[356] These planning considerations obviously go well beyond the focus of this thesis and demonstrate that legal considerations are only a small part of the ground water planning process.[357] These factors do, however, emphasize the need for lawyers and policy-makers to cooperate with a wide variety of professionals to ensure that legal and institutional structures do not unnecessarily compromise the hydrogeological and economic goals of ground water management. The author of this thesis would be remiss in not pointing out the need for such cooperation. Nowhere is this more important than at the aquifer designation stage of the management process. After all, the power to select management area boundaries is, in large part, tantamount to a decision to conserve or waste ground water.

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[355] See American Society of Civil Engineers, "Ground Water Management" in *Manual or Engineering Practice*, No. 40 (1972) at 216, *excerpt in*, Todd, *supra* note 7 at 359-360, fig. 9.2-9.3.

B. Designating Ground Water Management Areas

First, a protocol must be developed for designating ground water management areas before instituting ground water management plans. The designation process involves two interdependent considerations: the magnitude of the problem and the geographic extent of the ground water resource.

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[356] *Ibid.*

[357] For example, this thesis only discusses the planning considerations numbered 14 through 17.

1. Criteria for Designation

A problem of sufficient magnitude must exist before the decision to designate a ground water management area is justifiable. Problems that pose unreasonable risks to the economic or social well-being of present or future generations or to the aquatic or natural environment justify aquifer designation.[358] Several jurisdictions have developed criteria for evaluating such ground water problems, and for designating ground water management areas. As Professor Aiken states:

> Criteria for designating critical areas vary considerably and include: (1) withdrawals approaching or exceeding an aquifer's "safe yield" or recharge, (2) ground water level declines, (3) conflicts between ground water users, (4) water quality degradation, and (5) land subsidence.[359]

All of these criteria (previously identified in chapter three as pressing ground water problems) may warrant designation of ground water management areas. Additionally, water administrators should be given the discretion to consider other criteria that may arise, such as adverse effects on endangered species.[360] A nonexclusive list of criteria should thus be enumerated in legislation so that administrators have some frame of reference for making designation decisions. Such criteria would also make the designation process more evident to the public and stakeholders. The more transparent the designation process, the more reassured developers and environmentalists will be. Certainty of rights is an important starting point for both prudent development and environmental protection.

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[358] See generally Peterson, *supra* note 23 at 1410-1412 (listing environmental, economic, and social criteria for designation of critical areas).

[359] Aiken, *supra* note 242 at 515.

[360] Protection of endangered species is one of the considerations involved in the management of the Edwards Aquifer near San Antonio, Texas. See R.T. Hay, "Blind Salamanders, Minority Representation, and the Edwards Aquifer: Reconciling Use-Based Management of Natural Resources with the Voting Rights Act of 1965" (1994), 25 St. Mary's L.J. 1449.

Alberta's past water management initiatives have not been "transparent" to the public in the sense that they have not been based on statutorily mandated legal or hydrogeological criteria. As of the writing of this thesis, Alberta only had one approved water management plan,[361] which does not cover ground water withdrawals. This management plan, not unlike Alberta Environment's *Policy on Ground Water for Oilfield Injections Purposes*,[362] is a purely an administrative creation based on no statutory guidelines. Although administrators with Alberta Environment may consult stakeholders or inform the public of their management considerations, there is no legal guarantee that this must happen.

However, ground water management plans will soon have a statutory basis. The *Water Act* vests the Minister of Environment with the power to decide whether a ground water problem is serious enough to warrant creating a ground water management area. Section 10 of the *Water Act* provides that: "The Minister may establish water management planning areas for the purposes of developing or implementing a water management plan or approved water management plan." The Ministerial designation power mentioned in the *Water Act* differs from the approach used in a number of American states, where private individuals petition water administrators to designate management areas.[363] Alberta has apparently ruled out using a formal petition system by giving the Minister of Environment the *discretion* to designate management areas. However, the public and stakeholders may informally ask for a designation *vis a vis* public consultations and input into the planning process.

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[361] de la Cruz, *supra* note 30 (identifying the Beaver Lake Water Management Plan).

[362] See Chapter Two of this thesis, *supra* at part F.1.b.i.

This discretionary approach might allow the Minister to make better decisions if greater technical information is available to the Minister than to local petitioners. On the other hand, vesting the Minister with the sole authority to designate management areas has its dangers. With the downsizing of government, provincial agencies may not be in the best position to undergo or evaluate complex hydrogeological studies. Furthermore, powerful lobby groups might be able to influence the Minister's decisions in a way that a public petition system might not allow. Without engaging in a full scale debate of the

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[363] As S.B. Peterson summarized:

> Some states allow a hearing upon the petition of a fixed number of users in the area. Wyoming, for example, requires a hearing on the petition of five persons owning water rights in the groundwater area. Oregon allows for a hearing upon a petition from "any ground water claimant or appropriator within the area in question" if the Water Resources Commission considers a hearing to be warranted. Other states require petition by a fixed percentage of registered voters in the area. Arizona sets the requirement at ten percent. Other codes require a fixed number of users or a percentage of users, whichever is less. Montana, for example, requires a petition signed by at least twenty users or one-fourth of the users, whichever is less.

Peterson, *supra* note 23 at 1411-1412.

Ministerial designation process, this writer submits that it remains advisable for the Minister to establish criteria for designation, instead of relying solely on his or her discretionary powers. Ground water mining, well interference, nonconjunctive management of water resources, waste, and ground water contamination would be a good set of designation criteria that would limit the Minister's broad discretionary powers. Other criteria might include land subsidence, aquifer compaction, and anything having an adverse effects on essential ground water supplies or ecologically sensitive areas. These criteria might be incorporated into the *Water Act* through amendments to the Act itself or in the planning framework mandated by the Act.[364]

2. Designating Management Area Boundaries

The Minister would have to establish management boundaries as part of the responsibility for designating ground water management areas.[365] The boundaries of an aquifer or system of aquifers usually correspond with the boundaries of drainage basins. Hydrogeologists insist that the boundaries of a management unit should be coextensive with drainage basins.[366] For example, Professor Todd notes that ground water management is most effective when the boundaries of a management unit correspond with such physical boundaries. He states that:

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[364] *Water Act*, s. 7.

[365] See *Water Act*, s. 12(3)(b) (requiring Minister to describe geographical area of an approved water management plan).

[366] Toth, *supra* note 327. Dr. Toth remarked that aquifers often exist in interrelated units called "flow systems". Ground water management areas should also be coextensive with flow systems. *Ibid*.

> Maximum development of groundwater resources for beneficial use involves planning in terms of an entire groundwater basin. Recognizing that a basin is a large natural underground reservoir, it follows that utilization of groundwater by one landowner affects the water supply of all other landowners. Management objectives must be selected in order to develop and operate the basin. These involve legal, political, and financial aspects. Typically, optimum economic development of water resources in an area requires an integrated approach that coordinates the use of both surface water and ground water resources. After evaluation of total water resources and preparation of alternative management plans, action decisions can then be made by appropriate public bodies or agencies.[367]

Management programs are more effective and efficient when they are correspond with hydrogeological boundaries. By using the basin concept, it is impossible to 'gerry-mander' aquifer boundaries to exclude heavy ground water users or polluters from a ground water management area. Physical boundaries also ensure that a management area only contains users who affect ground water supplies, thereby not overregulating users who do not affect the ground water in a sensitive aquifer. Finally, using physical drainage basin boundaries to define management areas encourages conjunctive management of ground water and surface water resources. Integrated management of both resources eliminates the uncertainties and problems caused by nonconjunctive management.[368]

The problem with designating management areas using the basin concept, however, is that ground water underlies municipal, provincial, and international political boundaries.[369] Aquifers also underlie diverse types of economic developments. As

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[367] Todd, *supra* note 7 at 353.

[368] See Chapter Three of this thesis, *supra* at part B.4.

[369] *Cf.* D.A. de Lambert, "District Management for California's Water" (1984) 11 Ecology L.Q. 373 at 391 (observing that California has often used municipal boundaries to designate ground water management areas, rather than aquifer boundaries).

Karvinen and McAllister explain:

> each watershed area not only will have its own particular physical characteristics, but will be the subject of unique user requirements which depend on the local economy and the nature and extent of development in the area. Patterns of economic activities and trade rarely take into account environmental considerations, and they often extend far past the boundaries of local watersheds.[370]

The Minister must consider all these competing concerns as part of the designation process. For example, it is important to include recharge and discharge areas within boundaries of the management area.[371] Allowing land use development over a recharge area may reduce an aquifer's rate of recharge. This occurs when land use developments place impervious cover over the recharge zone. Parking lots, for example, act like asphalt "membranes" and prevent precipitation from seeping into underlying recharge zones. Such developments reduce ground water recharge, lower water levels, and undermine ongoing conservation efforts that might otherwise be sufficient to prevent ground water mining. The Minister should inform municipal development boards about such sensitive hydrogeological features and, if possible, include provisions in the ground water management plan to regulate development over these areas. In the end, the designated management area may not exactly correspond with basin boundaries, but a legal framework requiring consideration of physical criteria at least ensures that officials make an *informed* and *conscious* decision to deviate from basin boundaries. After the boundaries are set it then becomes time to select the appropriate administrative entity for the management area.

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[370] Karvinen et. al, *supra* note 1 at 102.

[371] Toth, *supra* note 327 (discussing the effect of well placement and land developments on aquifer recharge and discharge).

C. Selecting Ground Water Management Entities

Jurisdictions basically choose one of three institutional frameworks for implementing site-specific management plans: (1) central administration; (2) local administration; or (3) regional administration.[372] The following is an overview of each type of management framework.

1. Centralized Administration

A centralized system of ground water management usually vests all decision-making power in a state or provincial water administrator. This administrator has the responsibility for implementing and supervising ground water management plans. In the abstract, centralized administration is a "top-down" model that allows the administrator at the "top" to devise ground water management programs for the benefit of the water users "below".[373] In practice, central administrators often rely on local stakeholders for some measure of input. Many centralized systems delegate some of their decision-making power to regional administrators or local authorities. Such delegation blurs the distinction between the three different institutional management frameworks identified above, depending on how much decision-making power is retained by the central authority.[374]

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[372] This author recognizes that it is artificial to group all management entities into one of these three categories. Some entities have a mix of centralized, local, and regional attributes. Nevertheless, these categories form a useful framework for analysis.

[373] See Kelly, *supra* note 245 at 2 (advocating a centrally administered, state-wide ground water plan "that imposes mandatory, need-based quotas on all groundwater users.").

[374] Note that the proposed Act, while it centralizes decision-making power in the Minister to approve water management plans, also allows the Minister to delegate this authority to "any employee of . . . the Government . . . or a local authority". *Water Act*, s. 159(1). If the Minister delegated ground water planning functions to local authorities this would facilitate local ground water management.

The Arizona *Groundwater Management Act*[375] is a good example of a centrally administered ground water management framework. The Arizona Act creates four "active" ground water management areas and vests the state Director of Water Resources with full authority to manage all water in the state.[376] Kyl notes that the Arizona scheme "placed almost total regulatory control in the hands of one person appointed by the Governor, the Director of the new Department of Water Resources."[377] The Director of Water Resources thus has the responsibility to designate all critical basins and sub-basins in the state. Based on such designations the Director determines several of the rights and liabilities attaching to the transportation and use of ground water.

Not only did Arizona centralize decision-making power in one administrator, it also took the bold step of legislatively reclassifying all pre-existing ground water rights as either grandfathered rights, service area rights, or special permit rights.[378] Different types of grandfathered rights exist and belong almost exclusively to agricultural users, depending upon the use and productivity of their land and their past water consumption. Service area rights belong to residents within municipal boundaries. Such users have no right to water apart from their municipal contract with the municipal water service provider. Any restrictions on use are imposed on the municipal authority, which would then be responsible for imposing a conservation plan to meet state directives. Permit rights are obtained directly from the state water authority. These rights may be awarded for a variety of purposes, including dewatering for mining activities, industrial use, electrical generation, and drainage.[379]

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[375] Ariz. Rev. Stat. Ann. ss. 45-401 to 45-636 (West 1994).

[376] See *ibid* ss. 45-102 to 45-133, 45-412 to 45-417.

[377] Kyl, *supra* note 324 at 472.

[378] See Ariz. Rev. Stat. Ann. ss. 45-511 to 45-528.

The Arizona Act also announced a three stage conservation plan, which is designed to significantly reduce ground water use, retire agricultural lands, and achieve safe yield by the year 2025.[380] The primary mechanism for achieving safe yield is a series of three ten-year conservation plans. Each plan imposes more stringent water conservation requirements than the last, including mandatory retirement of certain agricultural lands.[381] Industrial users will also be burdened with water reductions and requirements to use the "best available technology" to conserve water. Municipal service providers will pass along per capita reductions to their users. As a further conservation measure, all new subdivision developments in the state must also show that they have an "assured water supply" for 100 years as a precondition to developmental approval.

Finally, the Arizona scheme levies a "pump tax" on water withdrawals. This tax amounts to $1.00 per acre foot for withdrawals during the second ten year period conservation period, and double that amount for the last ten-year period. The monies recovered from tax go to paying administrative expenses, and securing alternative sources of water through water imports or dams.

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[379] *Groundwater Management Act*, Ariz. Rev. Stat. Ann. s. 45-512(1)-(6) (West 1994).

[380] See generally K.L. Patrick & K.E. Archer, "Comparison of State Groundwater Laws" (1994) 30 Tulsa L.J. 123 at 129-131.

[381] Professor Tarlock comments in this regard that "Arizona's agriculture, especially cotton production, has long been economically irrational, but the state is perhaps the first to adopt a statewide program to move systematically water from lower to higher value uses." A.D. Tarlock, "An Overview of the Law of Groundwater Management" (1985) 21 Water Res. Research 1751 at 1756 (citations omitted) [hereinafter Tarlock, Overview].

These measures clearly show that Arizona has opted for a "heavy-handed" regulatory model of ground water management. Given the seriousness of the problems in that state, strict central administration is understandable. Arizona's critical ground water problems demand an *immediate*, *state-wide* response that would be hard coordinate between numerous local management entities. Notwithstanding, there is a small measure of local input in Arizona. Local ground water advisory councils make recommendations to "local directors" within active management areas.[382] These directors then report to the state Director of Water Resources. Although local users do not have any direct decision-making authority, their political influence and power at the ballot box give local residents indirect input into water policy and decision-making.

2. Local Administration

If central administration is at one end of the institutional spectrum, local administration is at the other. Local administration is based on the idea that local users are best able to manage their own ground water resources.[383] Municipal governments and special districts are typically used to administer local ground water management plans.[384] Local administration does not necessarily require each local authority to develop its own ground water management system. Several local entities are guided by minimum standards and policies contained in their state's water legislation.[385] For example, a state water code might impose the requirement that no recharging aquifer can be driven into overdraft conditions except in emergency situations. Under that requirement, a local management entity could work out the specific water allocation details amongst competing users. Thus under local administration, local entities have some quantum of authority to select ground water management programs and make water allocation decisions even if somewhat constrained by overarching state water policies.

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[382] See Ariz. Rev. Stat. Ann. ss. 45-420, 45-421.

[383] See S.C. Nunn, "The Political Economy of Institutional Change: A Distribution Criterion for Acceptance of Groundwater Rules" (1985) 25 Nat. Resources J. 867 at 877 (arguing that local control of ground water is important in agricultural areas because "pump-irrigators will not support an alternative rule designed to increase security of future water availability if it strips the landowner of discretion and authority that is valued more highly than the future security.").

[384] See G.S. Weber, "Twenty Years of Local Groundwater Export Legislation in California: Lessons from a Patchwork Quilt" (1994) 34 Nat. Resources J. 657 at 689 (summarizing local management authorities).

Bowman has observed that Colorado, Kansas, and Florida contain local ground water management entities that operate with minimum state interference.

> In Colorado, the state Groundwater Commission has designated eight "groundwater basins" and set broad management policies for them. Within those basins, ground-water users may form "management districts" and determine pumping limits and other regulations. In Kansas, ground-water users may form "groundwater management districts" by petitioning the state. Areas requiring even more stringent water-use restrictions (called "intensive groundwater use control areas") may also be designated by local petition or by the management district board members. In rare instances, the Kansas Chief Engineer may designate an intensive-use area directly, as long as it is not within an existing management district. The Florida state legislature has divided the entire state into basins and mandated that water-resources-management be carried out within each basin; each basin is relatively autonomous with regard to management alternatives.[386]

Additionally, a variety of completely autonomous local management entities operate in California. These entities exist because the state water authority does not have jurisdiction to limit pumping or prevent overdraft.[387] Thus, local "special districts", legislatively created districts, and county governments all assume ground water management functions.[388]

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[385] See *e.g.* White & Kromm, *supra* note 290 at 279 (identifying how local districts in Colorado operate subject to broad state guidelines).

[386] Bowman, *supra* note 273 at 491.

[387] See Garner et al., *supra* note 273 at 1029.

Arkansas and Nebraska also use local entities to manage their ground water resources.[389] Arkansas splits the duty of designating critical ground water protection areas between the state water authority and the local management entity. The state water authority first designates the management area and holds public hearings on ground water concerns within the region. The state water authority must then follow the *Arkansas Administrative Procedure Act* to provide an opportunity for public notice and comment on its ground water designation. The second prong of the designation process requires the state water authority to create the local management entity and establish regulatory authority for the local entity to implement a regulatory program through a system of water rights. Because the Arkansas scheme protects grandfathered rights, the local authorities will have their primary impact by restricting water use amongst new ground water users. The Arkansas scheme is new and remains largely untested. Many details are missing on how the local entity will make allocation decisions. Commentators also criticize the scheme for having under ambitious conservation goals given the protection of grandfathered rights, although they note that there is broad language in the Act allowing authorities to review and modify rights.[390]

Nebraska is more experienced in local ground water management than Arkansas.

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[388] See Garner et. al, *supra* note 273 at 1030.

[389] See *Arkansas Groundwater Protection and Management Act*, Ark. Code Ann. ss. 15-22-901 to 15-22-914 (West 1991). See also *Nebraska Ground Water Management and Protection Act*, Neb. Rev. Stat. ss. 46-656 to 46-674.20 (West 1993).

[390] See, *e.g.*, J.W. Looney, "Enhancing the Role of Water Districts in Groundwater Management and Surface Water Utilization in Arkansas" (1995) Ark. L. Rev. 643 at 656-657.

Nebraska's local Ground Water Conservation Districts originally undertook management responsibilities in the mid-1950's.[391] Although some of these districts still exist today, Nebraska has managed most of its ground water with local Natural Resources Districts since 1975. The few remaining ground water conservation districts will be phased out in 1997 and their functions and assets transferred to Natural Resources Conservation Districts.

Under the 1975 *Nebraska Ground Water Management and Protection Act*, Natural Resources Conservation Districts have broad powers to manage ground water withdrawals and implement conservation plans within designated ground water management areas.[392] District board members determine local ground water reservoir life goals and water quality protection goals. The districts then implement various site-specific programs to meet these goals. These local entities also integrate ground water management with other natural resource initiatives and land-use management plans within district boundaries.

Natural Resources Districts primarily use a system of licensing and permitting to control ground water withdrawals. The management entity will not issue a permit when it will cause an adverse impact on the ground water resources within the district. As section 46-660 of the Nebraska Act provides:

> An application for a permit or late permit for a water well in a control area or management area shall be denied only if the district in which the water well is to be located finds (1) that the location or operation of the proposed water well or other work would conflict with any regulations or controls adopted by the district, (2) that the proposed use would not be a beneficial use of water for domestic, agricultural, manufacturing, or industrial purposes, or (3) in the case of a late permit only that the

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[391] See Tarlock, Overview, *supra* note 381 at 1762.

[392] See Neb. Rev. Stat. ss. 46-614 to 46-634.01 (1993).

> applicant did not act in good faith in failing to obtain a timely permit....

To effectuate the policy of the state to conserve ground water resources the district may:

> (1) Adopt and promulgate rules and regulations necessary to discharge the administrative duties assigned in the act;
> (2) Require such reports from ground water users as may be necessary;
> (3) Conduct investigations and cooperate or contract with agencies of the United States, agencies or political subdivisions of this state, public or private corporations, or any association or individual on any matter relevant to the administration of the act;
> (4) Report to and consult with the Department of Environmental Quality on all matters concerning the entry of contamination or contaminating materials into ground water supplies; and
> (5) Issue cease and desist orders, following ten days notice to the person affected stating the contemplated action and in general the grounds for the action and following reasonable opportunity to be heard, to enforce any of the provisions of the act or of orders or permits issued pursuant to the act, to initiate suits to enforce the provisions of orders issued pursuant to the act, and to restrain the construction of illegal water wells or the withdrawal or use of water from illegal water wells.[393]

The district selects management programs based on its own expertise and hydrogeological studies, and upon the concerns raised at mandatory public hearings. In addition to presentations from local residents and associations, the district will consider any testimony presented by the Conservation and Survey Division of the University of Nebraska, the Nebraska Natural Resources Commission, and the Department of Environmental Quality. Following the District's promulgation of ground water controls and programs, all interested parties will be afforded an opportunity for further comment.

Once the district puts the ground water plan into final form, the state water administrator will review the plan and either approve it or send it back to the local district for revisions. This procedure gives the local district near absolute management authority of ground water within its boundaries, subject only to the state water administrator's veto power.

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[393] *Ibid* at s. 46-663.

Nebraska's local districts have broad revenue raising and enforcement powers that help them achieve their ground water management goals. Districts have, for example, the power to levy pump taxes and property taxes to implement ground water management programs.[394] This financial power enables districts to enforce ground water controls that are compatible the hydrogeological solutions reviewed in chapter three. As section 46-666 of the Nebraska Act provides:

> (1) A district in which a control area has been designated ... shall by order adopt one or more of the following controls for the control area:
> (a) It may determine the permissible total withdrawal of ground water for each day, month, or year and allocate such withdrawal among the ground water users;
> (b) It may adopt a system of rotation for use of ground water;
> (c) It may adopt well-spacing requirements ...;
> (d) It may require the installation of devices for measuring ground water withdrawals from water wells; and;
> (e) It may adopt and promulgate such other reasonable rules and regulations as are necessary to carry out the purpose for which a control area was designated.

A district's broad power to limit withdrawals clearly helps it achieve the goal of sustainable annual yield. Subsection (1)(e) also gives the district the power to implement other controls to achieve ground water management goals. Such controls might require the installation of efficient water distribution devices, such as lined irrigation canals or flow-reducing shower heads.

3. Regional Administration

Regional ground water management initiatives use a combination of centralized and local administration techniques. Regional management entities are, for example, comprised of local ground water stakeholders and state water administrators. Such entities try to balance central and local interests when making ground water management decisions. Decisions are usually made by a board comprised of stakeholders, state water officials, technical representatives, and community members. Sometimes these decisions are automatically binding on ground water users, at other times they require approval from a jurisdiction's chief water administrator.

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[394] *Ibid.* at s. 46-673 (allowing property tax levy of no more than one and eight-tenths cents on each one hundred dollars annually).

The Regina Aquifer Management Board is a regional ground water management entity.[395] It is made up of persons from the Saskatchewan Water Corporation ("Sask Water") regional office, Saskatchewan Environment and Public Safety, all municipalities that use ground water from the Regina aquifer system, and Consumers' Co-operative Refineries Limited — a major industrial ground water user.[396] The board's duties include: setting ground water management goals; sponsoring hydrogeological investigations and studies; initiating aquifer protection measures; compiling monitoring data; collecting ground water user fees; and recommending ground water allocations for approval by Sask Water.[397] The board recently declared a moratorium on ground water allocations from the Regina Aquifer System to help manage ground water as a renewable resource.[398]

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[395] See Clifton Associates, Ltd, *Final Report: Regina Aquifer Management Plan, Part A - Allocation Plan* (unpublished report available from Saskatchewan Water Corporation, 1989) at i [hereinafter *Regina Plan*].

[396] See *Regina Plan*, *supra* note 395 at 28.

[397] *Regina Plan*, *supra* note 395 at 29.

[398] Personal Communication from N. J. Shaheen, P. Eng., Sask Water Basin Operations, to author (December 1995) (remarking that no further allocations are currently being issued in the Regina Aquifer System).

Although the management authority is still in its formative stages, it seems likely that the authority will be funded through a combination of provincial funds and local user fees. The provincial funds would presumably be allocated to Sask Water and then passed on to the regional authority. The regional authority would, in turn, charge whatever user fees or pump taxes necessary to raise the funds necessary to implement its management plans.

The advantages and disadvantages of each of the management approaches must be evaluated before deciding on a management entity. Intuitively, the proliferation of different management entities indicates that no single institution is appropriate for all types of ground water management areas. As a preliminary report on the Regina Aquifer Management Plan explains:

> In all jurisdictions, the groundwater management policy is a function of the hydrogeologic understanding of the aquifers. The administration model is evenly divided between those where authority is vested in local boards and those where the state retains administrative authority.[399]

D. Some Problems With Ground Water Management Entities

Each type of management entity has substantive problems. The main criticism of local management is that it is corruptible and may only serve the interests of a portion of the community of ground water users.[400] An influential group of stakeholders may, through political or other means, gain a disproportionate influence on the local ground water authority where it would be more difficult to do the same with a centrally administered agency. This was certainly the case in south central Texas where several minority interest groups alleged that the legislatively created local ground water management entity only represented the interests of the business leaders and military bases in the Edward Aquifer area. Local self interest also is a problem when a ground water resource is important on a regional, provincial, or national scale. For example, Alberta must allow fifty percent of the surface water in the province to pass downstream into Saskatchewan under the Prairie Provinces Water Board Agreement.[401] If poor local management of an interconnected ground water aquifer puts surface water obligations in jeopardy, the province and all water users may face serious consequences. Thus, mismanagement by local administrators may harm people outside the management area. This might also occur, for example, when local ground water managers continue to mine an aquifer until the state "capitulates" and pays for an expensive and arguably unnecessary dam or "rescue" project.[402] Moreover, local administration may detract from efforts to pass large-scale amendments to the state water code.[403] Perhaps if local administration had not been used in Texas and California, ground water problems might have become so critical that the state legislatures would have been required to improve their water codes rather than relying on local initiatives. One can argue that holding out for state-wide change might be more effective in the long-run than using a "patchwork" of local management entities. This, of course, is not a potential criticism of local management in Alberta because, depending on the level of Ministerial delegation, the *Water Act* is compatible with local, regional, or centralized management.[404]

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[399] *Regina Plan*, *supra* note 395 at 11.

[400] See Bowman, *supra* note 273 at 497.

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[401] PPWB, *supra* note 25.

[402] See Trelease, *supra* note 21 at 873 (noting that California is in a "vicious circle of overdraft-rescue").

[403] Bowman, *supra* note 273 at 485.

Centrally administered management entities are criticized for being inefficient. This inefficiency can be the product of the high administrative overhead or overregulation associated with a top-down, "command and control" model of water management. Central administration can also be unresponsive to local concerns. A locality may have a vested interest in preserving a certain type of economic activity, whereas central administrators may be more sympathetic to certain state-wide goals or to the interests of a particularly powerful lobby.[405] Even if these administrators consider local concerns, the fact that local stakeholders are excluded from the decision-making process can build resentment in the local community. This resentment may lead to noncompliance with management efforts and higher enforcement costs.

Regional administration can be criticized as being nothing more than central administration in disguise. Local support for management orders will probably decrease if local input is not taken seriously. Environmental groups have withdrawn from regional planning activities for this very reason.[406] Additionally, the difference in opinion of people on regional management boards may be so great that it is impossible to reach consensus on many management decisions. When this is the case ground water problems worsen as managers try to strike an acceptable compromise.[407] An agreement on shared decision-making power between local and central managers may also take a long time to negotiate, delaying management solutions and leading to further ground water problems.

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[404] *Water Act*, s. 7(2)(d) (allowing, but not requiring, opportunities for local and regional involvement in water management planning).

[405] See Bowman, *supra* note 273 at 497.

[406] For example, Alberta's major environmental groups condemned the *Special Places 2000* protected areas strategy and rule out further participation in the planning initiative. S.A. Kennett, "Special Places 2000: Protecting the Status Quo", *in*, Resources Newsletter No. 50 (Calgary: Canadian Institute of Resources Law, Spring 1995) at 1.

Although each type of management entity has its problems it is also true that each type of entity can be effective. This is not to say that each type of entity works well in all situations, but each type of entity has been successful somewhere. For example, the local Orange County Water District has increased aquifer levels, reduced mining, and operated continuously since the 1950s.[408] The local districts in the High Plains region of Colorado and Kansas have slowed ground water withdrawals with the support of the majority of irrigation users.[409] In comparison, Arizona's centralized ground water management framework received the support of municipalities, mining companies, and agricultural users, even though these users are in bitter competition for water.[410] Perhaps only such a heavy-handed approach could have forced a solution between such fundamentally opposed groups. State power is sometimes necessary to bring different interest groups together for the purpose of creating an acceptable legislative compromise.

These examples show that each type of entity is useful in certain situations. Based on the successes and failures of different management entities, Alberta must try to select the management entity best suited to the conditions of each particular management area.

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[407] See Aiken, *supra* note 242 at 517.

[408] See Smith, *supra* note 205 at 823-824.

[409] See White & Kromm, *supra* note 290 at 306 (reporting that their "[d]iscussions with a wide array of state and local officials, farmers and other area residents, and agricultural professionals in the public and private sectors reveal very strong support for the idea of local groundwater management and general agreement with most of the programs initiated by the districts.").

[410] See Kyl, *supra* note 324 at 481, 503 (observing that despite the disparate interests of the major ground water consuming groups, the Act was passed and "is a thorough blueprint for state management and regulation of ground water.").

E. Using Multiple Ground Water Management Entities in One Jurisdiction

As suggested above, ground water management entities are not always the product of good planning. Some jurisdictions would probably have different ground water management frameworks if they did not have to fit ground water management principles into a less than perfect water code. When wholesale revision of a state's water code is impracticable, a ground water management entity may only be a "band-aid" solution. The experience of California and Texas illustrate this problem. Both states do not have comprehensive ground water management programs.[411] Instead, each state uses local management authorities to regulate ground water withdrawals on a case-by-case basis.[412] These states did not evaluate the prudence of using local ground water management entities in the abstract. The development of local ground water management entities occurred because well-established legal doctrines prevented the establishment of anything different.[413] The development of ground water law in California and Texas shows that the selection of management entities is not always the product of comparative analysis.

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[411] See Garner, et. al, *supra* note 273 at 1030-1038 (showing similarities in California and Texas ground water law).

[412] Garner, et. al, *supra* note 273 at 1036.

[413] California, for example, was unable to pass a comprehensive ground water management act in the 1980s and the water code does not give the state water administrator jurisdiction to reduce pumping. Faced with these problems, Californians had no regulatory choice but to use local mechanisms for ground water management. Similarly, Texas has a long history of opposing state control of ground water resources. As the only western state to still follow the rule of capture, centrally sponsored ground water management entities were not an option in Texas. Local entities were again the only option for increased ground water regulation. See generally Garner, et. al, *supra* note 273 at 1030-1038.

When jurisdictions have had the opportunity to make a wholesale change in their water legislation, they have not uniformly chosen local or central institutions to manage their ground water resources. Nebraska and Arizona exemplify such divergent approaches. Arizona, faced with critical ground water shortages, used a state run central administration approach. Nebraska, with an abundance of water but faced with increasing use and local shortages, opted for local management of ground water through its scheme of local natural resource conservation districts. Although both legislative systems are too new to declare a total success or abject failure, they both seem to be promising institutional responses to complex ground water problems. Alberta may have aspects of both the Arizona and Nebraska ground water problems. In the interconnected flow systems of the Bow Corridor and Highwood River, water is in short supply and has critical importance to the economic and social well being of the area. The water shortages in those regions also have interprovincial dimensions as mentioned above, as the Apportionment Agreement bars further surface water withdrawals.[414] In such serious circumstances, this writer suggests that an "Arizona-type" centrally administered water institution might be best suited to address the problem. In contrast, the local ground water shortages and the allocative pressures faced in small rural communities may be best addressed by a local management entity. With few jurisdictional interests at stake, the experience of Nebraska, Kansas and other local management states indicates that a cohesive group of users is better able to manage their ground water than a state-run institution.

Although very little literature attempts to explain the effectiveness of different ground water management entities, Ostrom's research supports the view that a jurisdiction, like Alberta, can better allocate its scarce ground water resources by using a variety of management entities.[415] Ostrom argues that local entities thrive or fail based on situational factors.[416] Ostrom concludes that there are eight "design principles" important to "long-enduring" local resource management institutions:

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[414] See S.A. Kennett, *Managing Interjurisdictional Waters in Canada: A Constitutional Analysis*, (Calgary: Canadian Institute of Resources Law, 1991) at 56-57 (discussing PPWB agreement generally).

> 1. Individuals or households who have rights to withdraw resource units from the CPR [common pool resource] must be clearly defined, as must the boundaries of the CPR itself.
> 2. Appropriation rules restricting time, place, technology, and/or quantity of resource units are related to local conditions and to provision rules requiring labour, material, and/or money. . . .
> 3. Most individuals affected by the operational rules can participate in modifying the operational rules. . . .
> 4. Monitors, who actively audit CPR conditions and appropriator behaviour, are accountable to the appropriators or are the appropriators. . . .
> 5. Appropriators who violate operational rules are likely to be assessed graduated sanctions (depending on the seriousness and context of the offense) by other appropriators, by officials accountable to these appropriators, or by both. . . .
> 6. Appropriators and their officials have rapid access to low-cost local arenas to resolve conflicts among appropriators or between appropriators and officials. . . .
> 7. The rights of appropriators to devise their own institutions are not challenged by external government authorities. . . .
> 8. For CPR's that are part of larger systems: . . . Appropriation, provision, monitoring, enforcement, conflict resolution, and governance activities are organized in multiple layers of nested enterprises.[417]

Professor Ostrom notes that some of the "long-enduring" ground water districts near Los Angeles meet most of these design criteria.[418]

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[415] See Ostrom, *supra* note 306.

[416] Ostrom, *supra* note 306 at 60.

[417] Ostrom, *supra* note 306 at 90.

[418] See Ostrom, *supra* note 306 at 140-143 (noting that pumpers in the Raymond and West Basins in California negotiated settlements on ground water use through a local entity even though it would have been more economically advantageous to "race to the pump house" and withdraw as much ground water as possible).

Ostrom's research implicitly suggests that a central or regional ground water management entity should be used when it is impossible to satisfy the design criteria for local management. Many local management entities have failed in circumstances involving a large community of diverse ground water users.[419] The Arizona experience suggests that centralized administration might work well in these complicated situations. Thus, central or regional administration should become management options when conditions are not favourable for local management.

Alberta should consider using a full array of management entities as it may soon face a wide variety of ground water problems. For example, in the high water use area of the Bow Corridor a serious problem will arise if there is a dramatic increase in ground water withdrawals from the alluvial aquifers underlying the Bow River. If this occurs a water management plan would be needed and a management entity would have to institute programs to conjunctively manage the area's water resources. A wide diversity of interests in a large geographic area would be affected by such a management plan. It seems clear, therefore, that a local management entity would not work in this situation because it could not meet Ostrom's eight factors.[420] Although regional administration is a potential alternative, it would be very difficult to reach a power sharing agreement between all the interests in the Corridor. For example, it would be difficult to persuade the highly populated city of Calgary to agree to let agricultural users have an equal vote on management decisions, even if they consume as much water as the city. Centralized administration may thus be appropriate in this hypothetical case, especially in light of the far reaching provincial and interprovincial interests involved.[421]

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[419] See Ostrom, *supra* note 306 at 146 (explaining that local ground water management has been a miserable failure in San Bernadino County, one of the largest and most diverse counties in the United States). This same observation could be made of the Edwards Underground Water District in San Antonio, Texas.

[420] Like the San Bernadino example discussed by Ostrom, the Bow Corridor is large and complex geographical area which would not be conducive to local management. See *supra* note 35.

By comparison, local management entities might work well in small, cohesive communities of ground water users. Ostrom's research supports this conclusion. Unlike cohesive and successful California ground water management districts, some local irrigation districts in the third world were doomed to failure because of their size and diversity of users. Ostrom attributes these failures to five problems: (1) a large number of users; (2) users with little historical attachment to their land; (3) extreme ethnic and cultural diversity between users; (4) the opportunity for wealthier users to control water; and (5) the lack of physical control structures in the water works.[422] Extending Ostrom's logic, one might reasonably conclude that a large diverse group of users may doom a local ground water management entity to failure in Alberta.

Integrated resource management theory also supports the view that local management entities may, in certain situations, be better able to manage ground water resources than central administrators.[423] One can readily see that a large part of integrated water resource planning involves the local water user:

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[421] One of the provincial interests would be to honor its obligation under the Prairie Provinces Water Board agreement to allow 50% of the water in the Bow River flow into the province of Saskatchewan. See S.A. Kennett, *Managing Interjurisdictional Waters in Canada: A Constitutional Analysis*, (Calgary: Canadian Institute of Resources Law, 1991) at 56-57 (discussing PPWB agreement generally).

[422] Ostrom, *supra* note 306 at 166.

[423] A full description of integrated-resource-management theory and its interface with ground water management is, obviously, well beyond the scope of this thesis. For more detailed information on integrated resource management the reader is directed to: R. Lang, ed. *Integrated Approaches to Resource Planning and Management* (Calgary: Univ. of Calgary Press, 1986). A.R.Petch, *Planning Integrated*

> Integrated water resource management implies the adaptation of a holistic and multi-dimensional approach to planning and decision-making on procurement and utilization of water resource through coordinated efforts that unify all user groups, managing agencies, interest organizations, and the general public to examine all implications of water uses, and to mitigate a wide range of possible impacts resulting from any water development activity or from the alternative conservation measures. In the wake of the existing imbalance of supply and demand situations, continued deterioration of water quality or environment, and intensified conflicts among all users, such an approach is essential to meet the challenges facing the whole society now and in the future.
>
> The key principle of integrated water resource management is the recognition of the interdependence of water resource, environment, economy, and the general societal well-being. Its strategic objective is to maintain the integrity of the affected aquatic ecosystem facing impacts from water use development.[424]

Local entities with the support of local ground water users may be more effective than central administrators in implementing remedial ground water programs for at least two reasons. First, the potential speed and effectiveness of local management is related to the fact that local ground water users are often in a position to take immediate remedial action even absent a formal ground water management plan. Like grass roots environmental movements, local ground water management entities are sometimes able to achieve results more quickly than central administrators because the impetus for change and formal or informal ground water solutions are communicated more quickly in the community itself. Scott and Scalmanini identify this local advantage when they say:

> It appears that in many cases local groundwater management can proceed under powers that are already available, particularly if specific groundwater problems can be

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Resource Management in Alberta, Lands Directorate, Environment Canada, Working Paper No. 43 (Ottawa: Minister of Supply and Services, 1985). *Integrated Water Resources Planning for the 21st Century* (New York: American Society of Civil Engineers, 1995). *Legal, Institutional and Social Aspects of Irrigation and Drainage and Water Resources Planning and Management* (New York: American Society of Civil Engineers, 1978).

[424] M. Chen, *Integrated Water Resource Management in Saskatchewan*, Report 92-2 (Regina: Saskatchewan Natural Resources, 1992) at 11.

> defined. Although some type of formal management plan would seem preferable, local entities can initiate a less formal exchange of information, which may include pointing out the problems of an increased number of wells and the potential of lowering water levels through mutual interference. In this way an owner may modify his levelling plans and water-distribution facilities and the location of this well so as to minimize such influences. It is also possible through analytical methods to calculate in advance predicted levels of drawdown and mutual interference of wells operated under various schemes of operation.[425]

Second, because integrated resource management is premised on the concept of "sustainability", and because local users and businesses have an immediate and direct effect on the sustainability of ground water resources, it is necessary to meaningfully involve local institutions in enduring ground water management plans from the outset. The failure to make local institutions responsible for ground water management poses the long-term threat of local users mismanaging the resource. Additionally, if central administrators withdraw or reduce support and/or supervision of ground water management plans, local users may be left without the understanding necessary to properly manage their ground water resources in the future.[426] Should the ground water

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[425] V.H. Scott & J.C. Scalmanini, "Groundwater Management at the Local Level—Theoretical Factors and Practical Experience" in *Legal, Institutional and Social Aspects of Irrigation and Drainage and Water Resources Planning and Management* (New York: American Society of Civil Engineers, 1978) at 353.

[426] Roark makes this point, albeit in the context establishing water supplies and sanitation programs in developing countries:

> In terms of development philosophy, it is the role of projects to assist local institutions to build their skills and resources so that they will be able to assist local institutions to build their skills and resources so that they will be able to sustain benefits. While this concept was implicitly presumed in most development efforts, it has only been recently that this concept was stated explicitly as part of project goals. The ability of the local institution to at least maintain, and preferably increase, the benefit stream is the ultimate test of sustainability. Future development efforts must place increased emphasis on local institution building as the foundation of sustainability.

P. Roark, "Sustainability in International Resources Water Supply and Sanitation in Developing resource be small and the local water demand great, mismanagement may pose an immediate and serious threat to the sustainability of the ground water resource. Thus, by involving local institutions in ground water management from the outset, local users are better able to identify with the benefits of remedial ground water programs. Knowledge of such benefits gives local ground water user an important measure of self-interest in proper ground water management. Self interest and understanding may enable local management entities to better protect the sustainability of ground water resources through changes in provincial governments, fiscal policy and environmental interest.

In the end, the limited research on ground water management entities suggests that Alberta should not settle on one type of management entity just because other jurisdictions have done so. Ostrom' research and integrated-resource-management theory suggest that Alberta's ground water management framework must be open to choosing from a variety of management entities to successfully address persistent ground water problems. The following chapter will consider how Alberta can introduce remedial ground water programs and select different types of management entities under the *Water Act*?

Countries" in *Integrated Water Resources Planning for the 21st Century* (New York: American Society of Civil Engineers, 1995) at 160.

CHAPTER FIVE

The *Water Act* is compatible with many of the remedial and institutional proposals made in chapters three and four. Although the Legislature did not specify the remedial and institutional measures that the Minister and Directors may take with respect to ground water in the province, it is clear that the drafters of the *Water Act* left room to include remedial ground water programs and institutional management guidelines at a later date. The *Water Act* is elastic and its reach can be expanded without legislative amendment. This is particularly apparent in the explicit statutory mandate to create a water management framework for the province,[427] and in the broad regulation-making power of the Minister of the Environment.[428]

However, not all of the proposals in this thesis are capable of being incorporated into the *Water Act*. The full utility of the remedial programs discussed in chapter three is abridged by the *Water Act*'s near absolute protection of existing licensees. Furthermore, although the *Water Act* contemplates local involvement in ground water management, it may stop short of giving local entities the power to make allocations. According to Ostrom's research,[429] the actual power to *make binding* allocative decisions is an important factor contributing to the success of local resource management entities, including ground water management entities.

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[427] See *Water Act*, part 2, div. 1, ss. 7-15.

[428] See *Water Act*, part 13, s. 169. Regulations are one type of subordinate legislation. See D.P. Jones & A.S. de Villars, *Principles of Administrative Law*, 2d ed. (Scarborough: Carswell, 1994) at 81-116 [hereinafter Jones & de Villars]. Subordinate legislation is as effective as parent legislation provided: (1) the regulations are not *ultra vires*; (2) the parent act has not been repealed; (3) the parent act is not *ultra vires*; (4) any statutory conditions precedent to enacting the regulations have been met; (5) the board, Minister or delegate enacting establishing the regulations has authority to do so; (6) the regulations are not in conflict with other acts; and (7) the subordinate legislation has been enacted in good faith and is reasonable. *Ibid.* at 112-114.

[429] See Chapter Four of this thesis, *supra* part E.

The remainder of this thesis will identify how the proposals in chapters three and four may be incorporated into the *Water Act*.

A. Implementing Remedial Ground Water Programs Pursuant to the Water Act

Chapter three proposed four areas in which site-specific remedial ground water programs may help solve persistent ground water problems.[430] These areas involve programs aimed at reducing waste, preventing well interference, controlling ground water mining, and promoting conjunctive management of surface water and ground water resources. Such remedial aims are entirely consistent with the purpose of the new legislation as set out in section 2 of the *Water Act*:

> 2. The purpose of this Act is to support and promote the conservation and management of water, including the wise allocation and use of water, while recognizing
> (a) the need to manage and *conserve* water resources to sustain our environment and to ensure a healthy environment and high quality of life in the present and in the future;
> (b) the need for Alberta's economic growth and prosperity;
> (c) the need for an *integrated approach* and comprehensive *flexible administration and management systems* based on sound planning, regulatory actions and market forces;
> (d) the *shared responsibility of all residents of Alberta* for the conservation and wise use of water and their role in *providing advice* with respect to water management planning and decision-making;
> (e) the importance of *working co-operatively* with the governments of other jurisdictions with respect to trans-boundary water management;
> (f) the important role of *comprehensive and responsive action* in administering this Act. [Emphasis added.]

All the remedial programs discussed in chapter three are essentially aimed at the wise use and conservation of water as described in section 2 of the *Water Act*. Moreover, remedial programs aimed at preventing ground water mining go to the long-term sustainability of ground water resources and the *Water Act*'s purpose of promoting a healthy environment and economic growth and prosperity *in the future*.

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[430] See Chapter Three of this thesis, *supra* part B.

Further support for incorporating the remedial programs discussed in Chapter Three can be found in those sections dealing with water management planning. Section 7(2) of the *Water Act* provides that the Minister's future framework for water management planning may include:

> (a) *water management principles*,
> (b) the geographical limits or boundaries within which water management planning is to be carried out in the Province, including limits or boundaries for the development of *strategic and operational plans*,
> (c) *criteria* for establishing the order in which water management plans are to be developed, ...
> (d) matters relating to *integration of water management* planning with land and other resources, and
> (e) matters relating to the development of *water conservation objectives*. [Emphasis added.]

Sections 8(2) and 8(3) of the *Water Act* also provide that the Minister must establish a strategy for the protection of the aquatic environment, which might involve the types of remedial programs discussed in chapter three. Section 8(2) and 8(3) read:

> (2) The Minister must establish a strategy for the protection of the aquatic environment as part of the framework for water management planning for the Province.
> (3) The strategy referred to in subsection (2) may include
> (a) identification of criteria to determine the order in which water bodies or classes of water bodies are to be dealt with,
> (b) guidelines for establishing water conservation objectives,
> (c) matters relating to the protection of biological diversity, and
> (d) guidelines and mechanisms for implementing the strategy.

Even though section 8(3)(a) targets "water bodies or classes of water bodies" for protection, water bodies are defined in the *Water Act* as including "aquifers".[431] The broad definition of water bodies can promote effective remedial ground water programs in light of the interconnectedness of all phases of the hydrological cycle and the importance of alluvial aquifers to surface water supplies in southern Alberta.[432]

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[431] *Water Act*, s. 1(hhh).

Finally, section 164 of the *Water Act* allows a Director to establish water management areas for the specific purpose of ground water management, and section 169(2) gives the Minister regulation making power:

> (b) defining, for the purposes of this Act ...
> (iv) problem water wells; ...
> (r) respecting the purposes for establishing water management areas; ...
> (dd) respecting measurement of water;
> (ee) respecting the remedial action and reclamation with respect to water wells and problem water wells and methods to be used and requirement to be observed in reclamation operations; ...
> (ll) respecting determining the sources of groundwater; ...
> (ccc) providing for any other matters necessary for the purposes of this Act.[433]

Regulation-making power extends to "problem water wells", the establishment of the purposes for water management plans, and the specification of remedial action with respect to problem water wells. These powers put the Minister in a position to incorporate the remedial ground water programs set out in chapter three into the *Water Act*.

The planning and regulation-making provisions set out above are compatible with introducing remedial ground water programs. Licensees under the *Water Act* might be made to follow certain water conservation objectives, well spacing patterns, pump requirements, or allocation limits all pursuant to the above provisions. Failure to comply with remedial programs instituted pursuant to water management plans or regulations would then trigger the water management order,[434] enforcement order,[435] and penalty provisions[436] in the *Water Act*. In essence, the *Water Act* includes the raw material to institute site-specific, remedial programs to solve persistent ground water problems, and to back up those programs with orders, penalties and an appeal process.[437]

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[432] See Chapter One of this thesis, *supra*.

[433] Note also that s. 169 puts in place the authority for the Minister to establish several technical requirements for the drilling, installation and operation of water wells. See *Water Act*, ss. 169(2)(ff)-(ww). As such, the Minister is in a position to repeal and replace existing water well regulations enacted pursuant to the *Water Resources Act*.

The *Water Act* is thus compatible with the remedial programs discussed in Chapter Three, but those programs may *only* be fully effective with respect to licenses granted *after* the *Water Act* is proclaimed in force. Section 18(2) of the *Water Act* preserves the priority and terms and conditions of licences for water users who acquired their licences under the old *Water Resources Act* or its predecessor legislation. Section 18(2) provides:

> (2) A person who holds a deemed licence under this section may continue to exercise the right to divert water in accordance with
> (a) the priority number of the deemed licence, and
> (b) the terms and conditions of the deemed licence and this Act, and if a term or condition of the deemed licence is inconsistent with this Act, that term or condition prevails over this Act.

Section 18's "grandfathering" of existing licensees is a serious limitation on effectively implementing remedial ground water programs. The nearly absolute protection extended to existing users virtually makes it impossible for all ground water users overlying an aquifer to "share the shortage" as there is no legal basis under the *Water Act*, short of emergency conditions, for new remedial programs to change the terms and conditions of old licenses. For example, shallow wells, improperly spaced wells, inefficient pumping rates, and inadequate pumps may all be protected under the terms and conditions of ground water licences issued prior to the *Water Act*. These factors may reduce the benefits of remedial ground water programs by preventing their implementation against old licensees. Only where an aquifer is exclusively used by new licensees will the full benefit of the remedial programs emerge, because only then can the *Water Act* truly force all users to share the shortage by equally observing or participating in remedial ground water programs.

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[434] *Water Act*, ss. 97-104.

[435] *Water Act*, ss. 135-140.

[436] *Water Act*, ss. 141-152.

[437] Appeals may lie to the Environmental Appeal Board. *Water Act*, ss. 114-117.

The drafters of the *Water Act* were presumably aware that any future remedial programs would be far less effective if existing licensees received security of title in their water rights. The decision to enact the *Water Act* was strongly connected to the preservation of existing water rights, and the draft legislation may not have been approved without this limitation.[438] The protection of existing licensees may have been the only workable policy alternative open to the legislators. In light of this limitation, the *Water Act*'s potential receptiveness to remedial ground water programs is nevertheless a significant step in the right direction. At a minimum, the remedial programs suggested in chapter three can affect new licensees. Abandonment or voluntary amendment or cancellation of old licences[439] may increase the role for remedial ground water programs in the future. So while the remedial ground water programs discussed in Chapter Three do not enjoy a perfect fit with the *Water Act*, they are nonetheless compatible with its purposes and planning mandate. As the new Act matures and ground water problems become more serious in the province, it stands to reason that remedial ground water programs will become increasingly important. For this reason, if none other, it seems desirable for the Minister to consider and implement remedial ground water programs as ground water problems develop in the future.

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[438] See Percy, "Seventy-Five Years", *supra* note 185 at 229.

[439] See *Water Act*, ss. 54-55.

B. Choosing Between Central and Local Ground Water Management Entities Under the Water Act

Chapter Four proposed that effective ground water management depends, in large part, on defining management area boundaries that are consistent with hydrogeologic boundaries. Where conjunctive management of ground and surface water resources is critical, management area boundaries will often correspond with basin boundaries. Aquifer or interconnected flow system boundaries may also define the effective management boundary for ground water resources, depending on the nature of the ground water resource.

Section 9 of the *Water Act* gives the Minister, Director or other person responsible for developing a water management plan the implicit authority to consider hydrogeologic boundaries in defining management areas. Section 9 provides:

> 9(1) The Minister may require a water management plan to be developed by the Director or another person.
> (2) The Director or other person developing a water management plan
>   (a) may adopt an *integrated approach* to planning with respect to water, land and other resources;
>   (b) may co-operate with
>   (i) any persons,
>   (ii) *local authorities*,
>   (iii) Government agencies and other Government departments, and
>   (iv) the governments and government agencies *of other jurisdictions*;
>   (c) may, with the consent of the Minister, *carry out any studies that the Director or*

> *other person considers appropriate*;
> (d) *may consider any information, documents or other water and land management plans*;
> (e) must follow the framework for water management planning established under this Division;
> (f) must engage in public consultation that the Minister considers appropriate during the development of the water management plan. [Emphasis added.]

Section 9(2)(d) authorizes planners to consider "any information", which implicitly includes hydrogeologic information. Additionally, the section seems designed to involve all parties with relevant knowledge and expertise in the integrated water management planning process. Hydrogeologists would obviously be prime candidates for involvement in the planning process and would, consistent with sound water management planning, recommend designating management boundaries consistent with basin and/or aquifer boundaries, as the case may be.[440]

Section 9(2)(b)(ii) of the *Water Act* permits the Director or other person responsible for developing a water management plan to co-operate with "local authorities". Section 9(2)(f) then requires the Director or person responsible to "engage in public consultation" during the development of a water management plan. Section 9 thus authorizes the person responsible for developing ground water management plans to consult with local authorities, such as those which represent ground water users in the affected area.[441] The broad public consultation requirement also ensures that local ground water users are guaranteed some voice in the initial planning process.

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[440] This is not to say, however, that site-specific management is appropriate for all ground water resources. Where the value of water in dispute is minimal, the existing prior allocation system of water rights is an efficient mechanism for resolving disputes. It would not be practical or economically efficient to subject every ground water resource to site specific management. Outside areas of intensive water use or critical water shortage, the existing prior allocation system brought forward in the *Water Act* provides an adequate "rough and ready" guide for resolving disputes between users on the basis of first in time, first in right. Additionally, site-specific management depends in large part on the data collected under the prior allocation system. Without the data collected under the *Water Resources Act* and *Water Act*, site-specific management would not be feasible. As such, site-specific management should be regarded as only a special method of regulation for the most sensitive ground water resources. Thus, it can be said that for all the inadequacies and shortfalls of prior appropriation and prior allocation, these systems work well under conditions of adequate water supply.

But the role of local authorities is not merely limited to "consulting" with water management planners. Section 6 of the *Water Act* goes further and allows contractual agreements with local authorities. Although section 6 does not expressly state that agreements may be entered into with local authorities for the purpose of assuming ground water management duties, it appears compatible with the management functions discussed in chapter four. Section 6 reads:

> 6 Subject to the Government Organization Act, the Minister may *enter into agreements containing any terms and conditions, including but not limited to* provisions for sharing of

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[441] Note that section 1(ff) of the *Water Act* defines "local authorities" in a manner consistent with including overlying ground water users in management functions. Section 1(ff) reads:

> (ff) "local authority" means
> (i) the corporation of a city, town, village, summer village, municipal district or specialized municipality,
> (ii) in the case of a special area, the Minister of Municipal Affairs or the Special Areas Board,
> (iii) in the case of an improvement district, the Minister of Municipal Affairs or the council of the improvement district,
> (iv) a settlement under the *Métis Settlements Act*,
> (v) a regional services commission established under the *Municipal Government Act*,
> (vi) the board of directors of an irrigation district within the meaning of the *Irrigation Act*,
> (vii) the board of trustees of a drainage district within the meaning of the *Drainage Districts Act*,
> (viii) the regional health authority under the *Regional Health Authorities Act*, and
> (ix) any other entity defined as a local authority in the regulations for the purposes of this Act;

If the above section is not enough to include a meaningful cross-section of users and interested persons in a local management capacity, section 169(2)(b)(iiI) gives the Minister of the Environment the power to make regulations "defining for the purposes of this Act ... an entity as a local authority".

> costs, with
> (a) a person,
> (b) *a local authority*,
> (c) a Government agency, or
> (d) the government or a government agency of another jurisdiction,
>
> with respect to
> (e) *any matter pertaining to the conservation and management of water*, including but not limited to the supply and control of water,
> (f) water-power development,
> (g) the use, operation, maintenance, repair, control, replacement or removal of works,
> (h) flood control and management,
> (i) trans-boundary water, and
> (j) *any other matter related to the administration of this Act.* [Emphasis added.]

Insofar as the *Water Act* merely permits, but does not require, cooperation or agreements with local authorities, it is also compatible with centralized ground water management. For if the Minister or Director responsible for developing a water management plan chooses not to cooperate or enter agreements with local authorities it will fall on the government to implement the planning framework and to make the necessary management and allocation decisions. Local input would be restricted to the public consultation phase of the planning process, but would not extend to the actual management decisions. Such an approach is consistent with the top-down, centralized approach taken under the *Arizona Groundwater Management Act* and may be efficient for arriving at water management solutions in highly populated areas with diverse ground water users.[442] Thus, a greater governmental planning involvement in areas such as the Bow and Highwood Rivers remains possible under the *Water Act* as local involvement is left to the discretion of the Director or person responsible for developing the applicable water management plan. It would be ideal if that discretion were exercised consistent with those factors, mentioned in chapter four, which indicate situations most suited to centralized administration.[443] Those factors might even be added as guidelines in the provincial water management framework pursuant to section 7 of the *Water Act*.

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[442] See Chapter Four of this thesis, *supra* parts C.1 and E.

With respect to creating local ground water management entities, sections 6 and 9 of the *Water Act* suggest that the Director or person responsible for developing a water management plan may enter into agreements with local entities. Such agreements might involve conducting hydrogeologic investigations, monitoring water use, helping implement remedial ground water programs, and even recommending water allocation decisions. As suggested in chapter four, a local management entity seems most likely to succeed when Ostrom's eight design factors are present.[444] These factors might also be incorporated into the provincial water management planning framework.

Although the *Water Act* is compatible with both local and central ground water management entities, it must be pointed out that the *Water Act* also creates an impediment to local ground water management. No section in the *Water Act* expressly states that the Minister, Director or person responsible for developing a water management plan may confer water allocation decision-making authority on a local entity. On the contrary, sections 2 and 9 of the *Water Act* only state that local persons or entities may "advise" or "co-operate" with government planners, but not "decide" how to make water allocation decisions. It is true that local authorities might "recommend" allocation decisions consistent with an advisory or co-operative role, but the Director or Minister has the final authority to issue water licenses under the current structure of the *Water Act*. Ostrom's research suggests that active participation in allocation decisions is one factor that is important to the survival of local management institutions, yet it may not be possible under the express wording of the new *Water Act*.

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[443] See Chapter Four of this thesis, *supra* part E.

[444] See Chapter Four of this thesis, *supra* part E.

Furthermore, principles of administrative law may bar local decision-making under the *Water Act*, even *assuming* that a Director or person responsible for a water management plan wants to delegate allocative decisions to a local entity. A statutory delegate may not contractually fetter decision-making authority unless there is statutory support for that inter-delegation.[445] The broad powers of the Minister and Director make it unclear whether section 6 of the *Water Act* will support delegating allocative decision-making functions to local authorities. The *Water Act* appears at cross purposes in this respect, for certain sections relegate local entities to a permissive advisory role, while section 6 allows the government to contract with local authorities for water management functions.

There is also a question whether a local entity constituted under its own by-laws or rules could make allocation decisions different from the Director or Minister who established that local entity under the *Water Act*. Although the Alberta case of *Hutterian Brethren Church of Starland v. Starland (Municipal District No. 47)*[446] suggests that a local planning entity may impose stricter ground water allocation decisions than provincial water authorities, it must be remembered that the local planning authority in *Hutterian*

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[445] See Jones & de Villars, *supra* note 428 at 172.

[446] (1991) 6 M.P.L.R. (2d) 67 (Alta. C.A.).

Brethren was exercising a planning function different from the provincial water or health authorities. Laux explains the reasoning behind such decisions as follows:

> The rationale for allowing planning bodies to canvass issues previously or yet to be addressed by other public agencies operating under specialized legislation is simple. The objectives of the other legislation may not be the same as that of the planning legislation, so a decision under that legislation would still leave considerable room for judgment calls under the planning regime. For example, an important objective of the *Public Health Act* is to safeguard the health of persons from the effects of airborne contaminants and odours emanating from nearby intensive livestock facilities. Hence, decisions made under that statute are aimed at that objective. In contrast, one of the prime objectives of a decision-maker operating under planning legislation is to achieve compatibility between neighbouring land uses to protect the use, enjoyment and value of the neighbouring lands.[447]

A local ground water management entity created under the *Water Act* would seem to have the same conservation and water management objectives as the government officials charged with instituting the relevant water management plan. Any variance between local and governmental decisions would, therefore, seem inconsistent with the rationale used in planning decisions.

This analysis suggests that the *Water Act* is set up with centralized ground water management as the default management style. Although the *Water Act* authorizes significant partnerships with local authorities and presumably allows water officials to adopt the allocative and remedial recommendations of local authorities, it does not seem capable of turning over actual allocative decision-making authority to local ground water management entities.

There is a less obvious argument for conferring decision-making authority on local water management entities. A local management authority could proceed on a "pre-approval basis" which neither violates principles of administrative inter-delegation nor Ostrom's recommendation for meaningful local participation. Local authorities in Alberta might approve of local ground water management plans *in advance* of implementation, just as local districts in Nebraska do.[448] After the pre-approval of ground water management plan by the Minister of the Environment a local authority would take over allocation and remedial decisions within the ambit of the management plan. On this view the local authority would not have to seek approval for every decision it makes, thereby maintaining its autonomy and importance in the management process. At the same time the Director responsible for the management plan may not have fettered his or her discretion because the approved ground water management plan would be akin to a "flexible policy" which may not result in an abuse of discretion.[449] Local authorities may thus properly be able to make decisions within the ambit of the water management plan, but without the constant interference of government administrators. Such an approach to local ground water management would enable water administrators to use the *Water Act* to achieve a full range of institutional management options—from almost absolute central administration to almost absolute local administration—depending on the hydrogeologic, social and political characteristics of the water resource in question.

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[447] F.A. Laux, *Planning Law and Practice in Alberta*, 2d ed. (Scarborough: Carswell, 1996) at 3-11.

The *Water Act* must be regarded as proceeding from the premise that centralized management is the default system for water allocation in the province. Nothing requires the Minister to exercise his or her discretion to involve local authorities in water management planning beyond mere public consultation. However, provisions are included in the *Water Act* for increasing local involvement in water management decisions, perhaps even beyond a mere advisory function up to the point of actual allocative decision-making within the ambit of an approved water management plan.

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[448] See Chapter Four of this thesis, *supra* part C.2.

[449] Jones & de Villars, *supra* note 428 at 169 observe that a delegate does not fetter his or her discretion by referring to another government policy when deciding to exercise his or her discretion. Perhaps a water management plan pre-approved by the Minister and administered by a local authority would insulate government officials from the objection that they were improperly delegating decision-making authority to local entities?

C. Conclusion

The *Water Act* is compatible with many of the site-specific remedial ground water programs and institutional management entities discussed in this thesis. Water administrators may implement a high degree of site-specific management of scarce ground water resources in Alberta through a pending provincial water management framework and broad regulation-making authority. Although the near absolute protection of existing licensees is a serious limitation on the effectiveness of remedial ground water programs, the *Water Act* may grow and mature to make greater use of remedial programs. Also because theories respecting water management institutions do not yield clear institutional solutions, the new Alberta *Water Act* seems appropriately flexible and receptive to a variety of institutional formulations.

Although some question remains about the exact extent to which the new Act permits local administration, there is not doubt that the new Act provides a much broader spectrum of institutional management than available in the past. A certain amount of trial and error and adaptation of management considerations to local conditions is to be expected as the *Water Act* produces its first few water management plans. Depending upon the success of those plans, the *Water Act* should remain flexible enough to rule out less useful management options, remedial programs, and institutional models.

However, one potential pitfall of the new Act is that it contains few statutory mechanisms to ensure that the Minister of Environment institutes water management plans which appropriately consider and implement environmental and hydrogeological principles, as well as avoiding certain social and economic consequences. For example, there is no statutory provision in the *Water Act* that forces the Minister to implement plans using the best scientific information. Theoretically, a water management plan may disregard sound scientific evidence of an adverse environmental effect in preference to an immediate economic gain. Furthermore, there are relatively few provisions in the Act that say the Minister "must" do certain things when developing a planning framework and creating management plans. Most of the Minister's statutory authority is discretionary. Obviously, the Minister must retain discretionary power to tailor water management plans to Alberta's varied hydrology and multiple uses. But excess discretion may also yield uncertain and potentially harmful results. The only real means of holding the Minister and water managers accountable for any poor water management plans (which do not use sound planning principles) is for the citizens of Alberta to vote out the offending administration during an election. More specific and immediate accountability measures are desirable and should be added to the Act in the future.

Notwithstanding the above weaknesses, the *Water Act* has set the foundation for site-specific management of scarce ground water resources in Alberta. All that remains is for officials to conscientiously incorporate the remedial and institutional considerations for effective site-specific management i[illegible]he provincial water management framework and applicable water management regulations.

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